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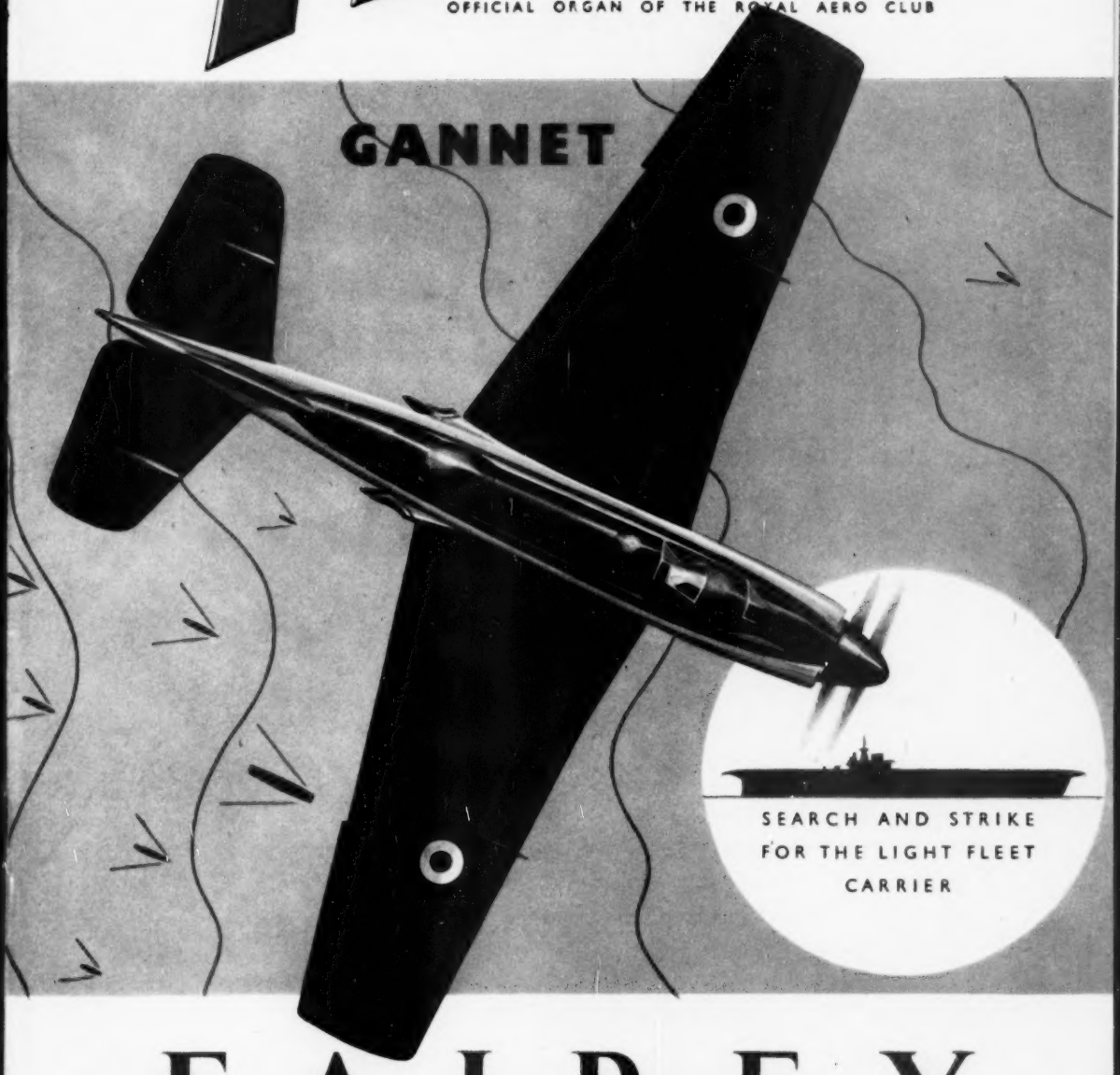

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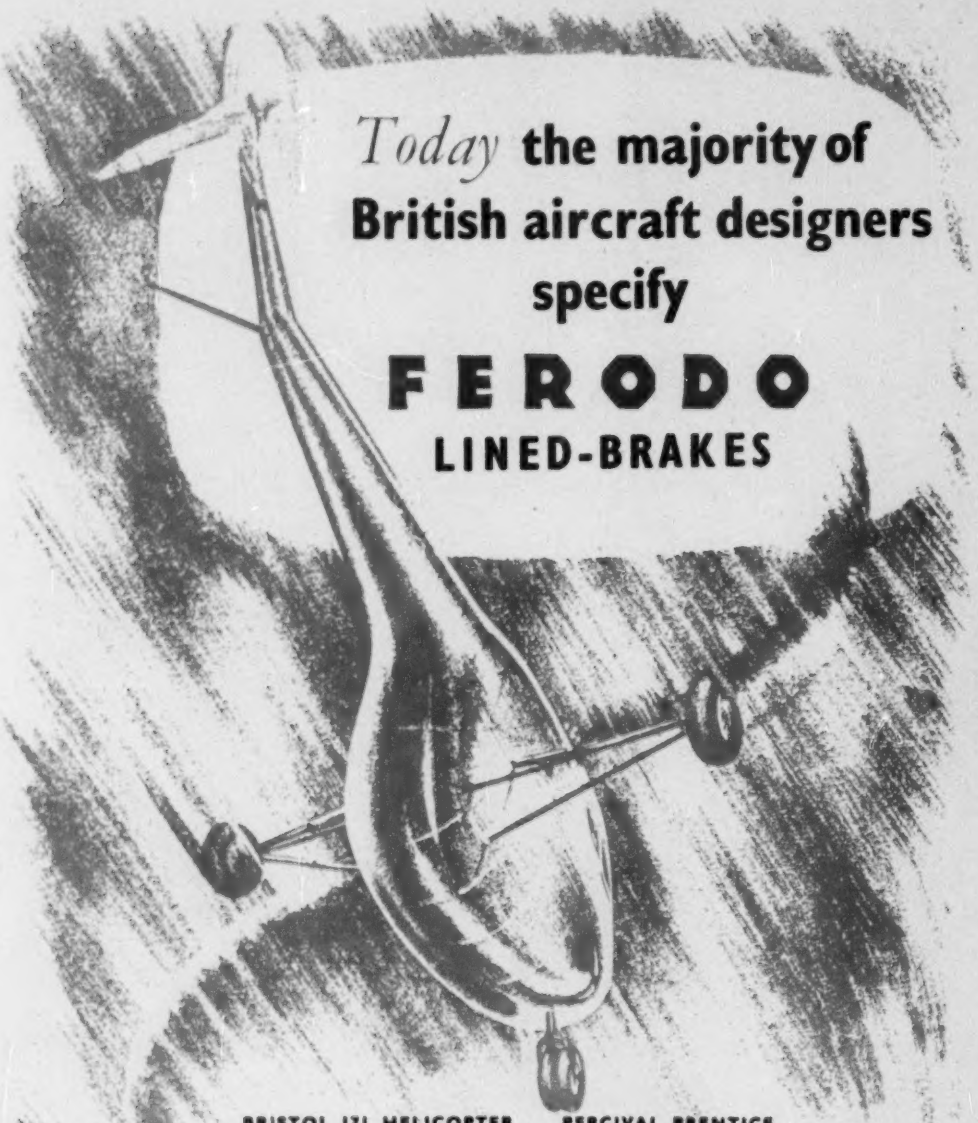

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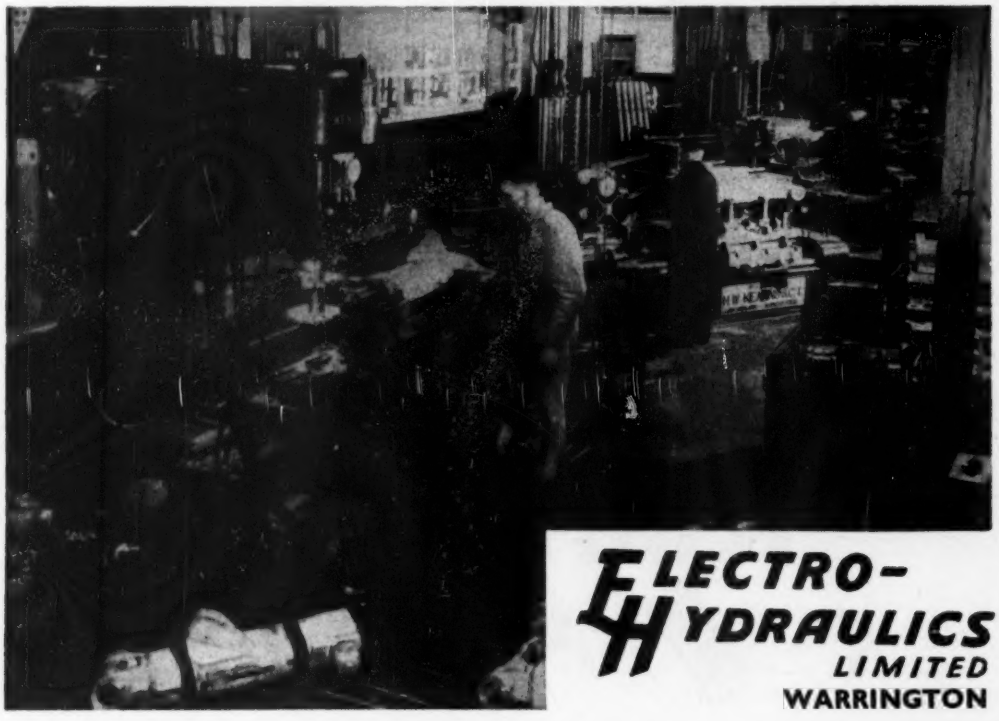

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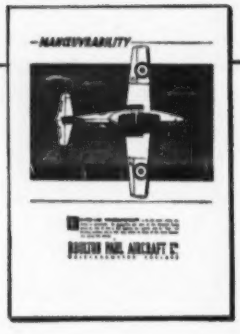

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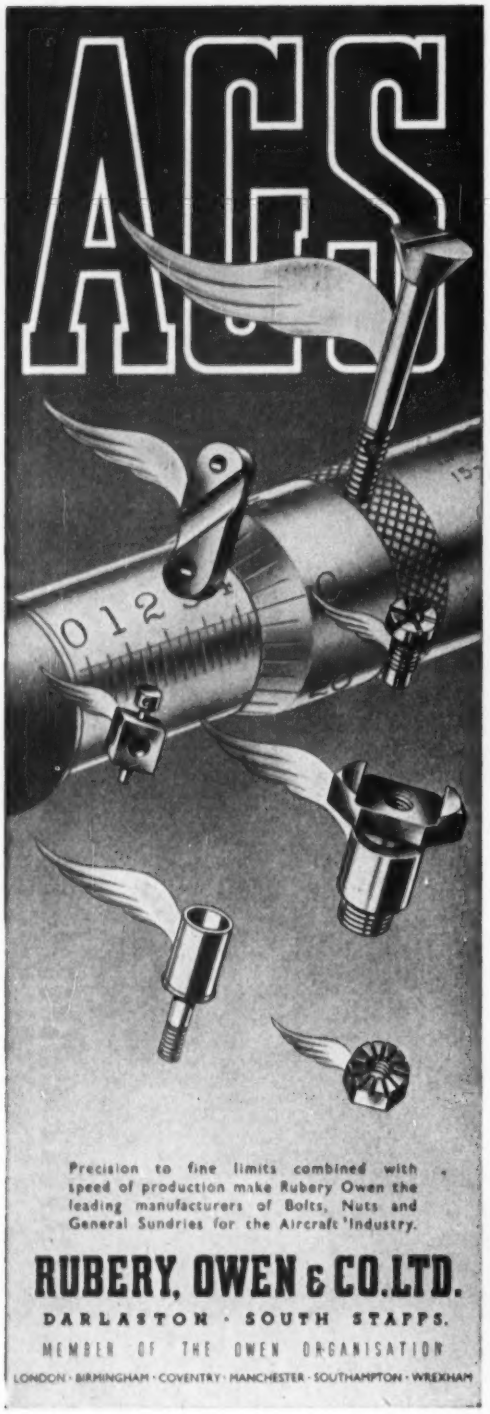
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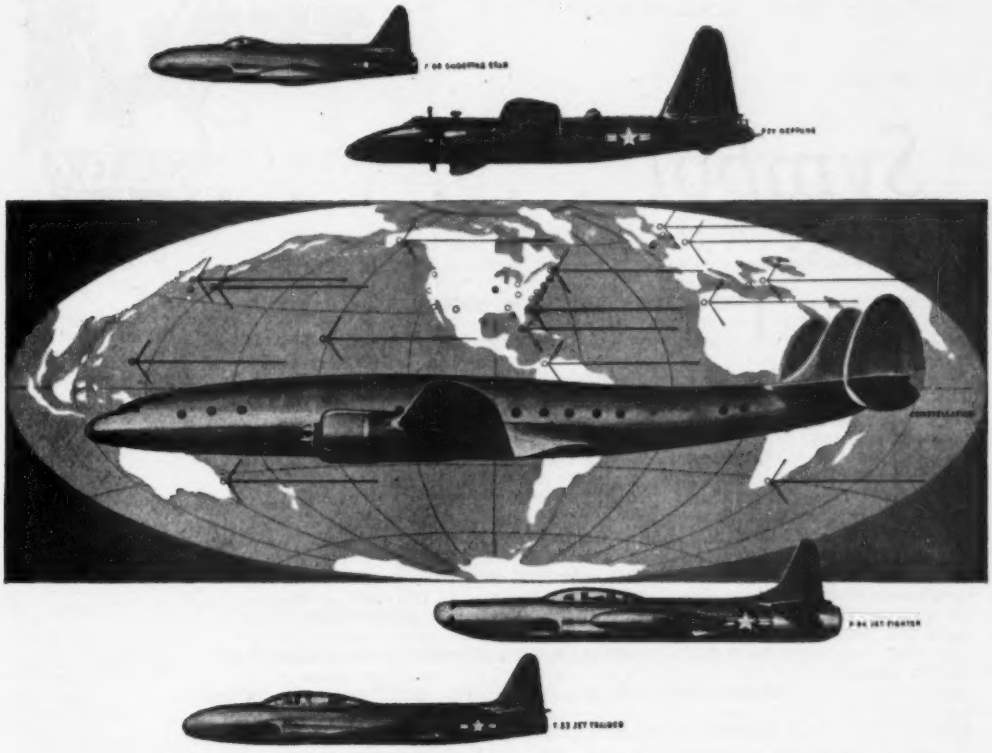

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IN THIS ISSUE:

Canberra in Service - - 58
Air Year Reviewed - - 63
Helicopter History - - 66
Indonesian-pilot Training - - - - - 68
Background to a Bomber - - - - - 71
Flutter - - - - - - 75

Lympne and its Future

SUCH are the requirements of a good airport today that very few are without defect: some are too near built-up areas, others are too far away; some suffer frequent fog and haze, others become waterlogged; and many of the good old-established sites have been so surrounded that they cannot be extended. Yet there remain others which, regardless of defects, have by virtue of their position survived through good and bad times and look like doing so for many years to come. Lympne is an example, though it has shortcomings (the word is appropriate in this context) that limit its use and handicap the development of traffic.

This, the Cinque Ports airfield, has long been known among private pilots at home and abroad as the hopping-off and landing point for cross-Channel flights. After worthy war-time service a battered Lympne was handed over to the M.C.A. by the Air Ministry on January 1st, 1946, and, thanks to the energy and enthusiasm of the local club, air races were revived there in the same year, and also held subsequently.

The future looked promising—until a loss of £17,000 for the previous year caused the M.C.A. to announce, in 1949, that the airport would be put up for sale.

Certain developments then took place which altered the whole picture, and the airport was not, in fact, sold. The primary reason was the building-up of the cross-Channel car ferry by Silver City Airways, Ltd., using Bristol Freighters. We are not in possession of the details of negotiations concerning the proposed sale, but we understand that the M.C.A. fixed a price; nobody was prepared to meet it and so the offer was withdrawn. From the prospective customer's point of view the story is explained rather differently. It seems that Silver City approached both Folkestone and Hythe Councils with the suggestion that one or other should share Lympne with them on a purchase-and-management basis, but neither was interested at the time. During the summer and autumn of 1949 the M.C.A. was still officially considering Silver City's approach. Matters dragged on until July 26th, 1950, when the airport was withdrawn from the market. By this time landing fees amounting to several thousands pounds per annum were coming in.

Having recorded this much of the background we now turn to the situation today. In its present condition Lympne is used almost to capacity during daylight hours by Silver City alone, and with winter contracts for cattle and foodstuffs this is becoming year-round traffic. No limit to expansion is seen at present, and orders for new Freighters have just been placed by the airline. In fact, the scale of this work has now brought it into the sphere of national importance.

Le Touquet, the corresponding airport on the French coast, is being further developed at a cost of £280,000 to take advantage of this ever-increasing tourist and freight traffic, yet little more than maintenance is being done at Lympne, which only last week was closed to all but light aircraft owing to the churned-up state of the grass.

Folkestone and Hythe Councils have now awakened to the importance of the Channel air ferry, and the former has set up an air committee. Alderman W. Hollands of Hythe said recently that more and more people were using the air route to the Continent; and that he felt sure that he and his fellow-hoteliers could accommodate these people better than would be the case in Folkestone. This sort of competition, we feel, at least ought to produce good accommodation.

But it is the M.C.A.—owners of Lympne—who should now be working out a development policy, or alternatively arranging to hand over the airfield to someone else who will. Although Lympne is one of the three busiest airports in this country, it does not even rate a resident airport manager. New buildings are needed, a new apron, and a perimeter track or lead-outs. Concrete runways would probably not be justified at this time. Who, it may be asked, would pay? One answer is that Silver City hand over £6 17s 6d for each landing, and in 1951 they touched down 2,892 times. Air Kruise also make a substantial contribution. Next year this figure will be much larger and, if the airfield can cope, will go on getting larger still. To us, Lympne appears to be a good investment.

CANBERRA in SERVICE

News and Views Concerning the R.A.F.'s Twin-Jet Bomber

Illustrated with "Flight" Photographs

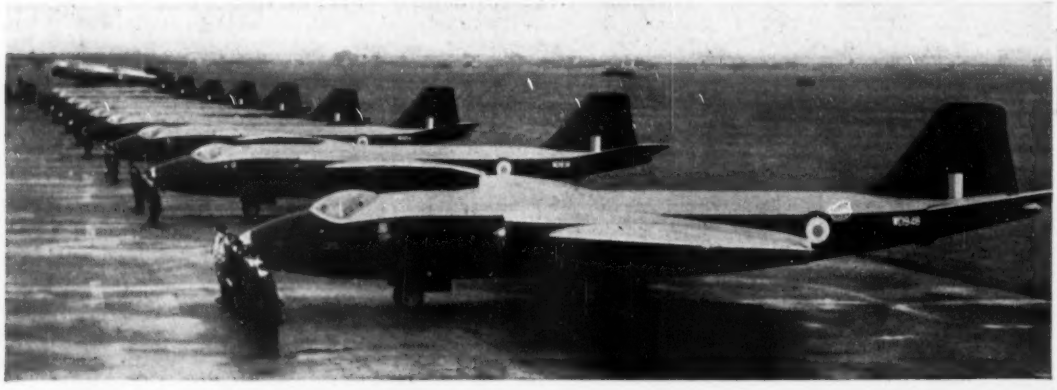
TO see the first jet-bomber squadrons of the R.A.F. we made our way, last week, to Binbrook in Lincolnshire. The aircraft are English Electric Canberra B.2s and already they equip No. 101 Squadron, while No. 617 has recently started to convert on to these excellent light bombers.

The Air Ministry is emphatic that introduction of the Canberra into R.A.F. service signals the start of Bomber Command *expansion*, and not merely a re-equipment programme. Selected crews from existing Lincoln (and, later, Washington) units will convert on to Canberras to form new squadrons, though the piston-engined machines must perforce remain in service, side by side with the jets, until the introduction of the four-Avon Vickers Valiant.

An account of the construction and development of the Canberra appears on pages 71-74 of this issue, and before giving an account of the Binbrook visit we are impelled to make some observations on operational aspects. The first of these is prompted by an official affirmation that the Canberra "will be able to carry a considerably more destructive load than the average war-time heavy bomber." On the face of it, assuming an "average war-time heavy bomber" to be a Lancaster, with a maximum bomb load of 14,000 lb, this is reassuring; but striking an average between the Whitley and Lancaster, and taking into consideration the Stirling and Halifax, and types of lesser capacity, such as the B-17, the figure arrived at (if, indeed, one can be arrived at by such a flimsy hypothesis) may not be very impressive. In any case, the photographs on page 72 prove that the Canberra's bomb bay is small by comparison with the Lancaster's.

It may be, of course, that the Air Ministry intends to intimate that deadlier explosives, of more or less conventional composition, have been developed since the war, or (and there is good reason to believe that this is so) that the Canberra will carry an atomic bomb, as will the North American Savage of comparable dimensions.

Nine 101 Sqn. Canberras at Binbrook. In contrast with the "leggy" Lincoln in the background, the jet aircraft have an oddly squat look.



Demonstrating the new vizor which is to take the place of tinted spectacles to subdue glare at high altitudes. The pilot and crew depicted are all wearing pressure waistcoats.

Formations of Canberras, like this echelon from Binbrook, will gradually become a familiar sight in British skies. Versions for bombing, target marking and photographic reconnaissance are already in existence.

But, whatever may have inspired this somewhat baffling pronouncement, it may be presumed that the Canberra packs —or will be developed to pack—a heavy punch in terms of effectiveness, if not of weight alone. As for its ability to deliver, we can only state our own opinions.

We must, in the first place, dissent from the view that the Canberra is the world's fastest bomber, for the experimental Martin B-51 may be anything up to 100 m.p.h. speedier at low and medium levels; but the British bomber possesses certain unique attributes which permit it to cruise very fast at heights of 45,000-50,000ft, as demonstrated in its trans-atlantic crossings in face of severe headwinds. At these extreme heights, where the best fighters are becoming leaden-winged, and their turbojets are gasping for breath, it retains, by virtue of its low wing loading, an altogether exceptional standard of manœuvrability, which would certainly cause many types of fighters to stall in bringing aim to bear. In this regard, however, it must be remembered that the Mig-15 has demonstrated high-altitude handling qualities superior to those of comparable British and American types.

As for accuracy of delivery, it may be remarked that the Canberra B.1 was foreseen as an "all-radar" bomber, but that the B.2 appears to have a conventional optical bomb-sight. The Air Ministry, however, has recently disclosed that it can bomb through cloud "by means of radar aids"—presumably a development of *Oboe*.

To summarize, the Canberra probably stands a better chance of reaching its target than any type of bomber now in service, and it will carry a worth-while load, though its ability to deliver this with the desired accuracy is at present open to doubt.

As the wind knifed and bludgeoned across the airfield at Binbrook we stood talking with various officers concerned with the introduction of the Canberra into R.A.F. service. There was G/C. N. C. Hyde (Station Commander); W/C. H. P. ("Pat") Connolly, D.F.C., A.F.M. (W/C. Flying); W/C. W. H. Herbert, O.B.E. (W/C. Technical); W/C. H. P. Jenkins, D.F.C. (W/C. Admin.); S/L. E. Cassidy, D.F.C. (O.C., 101 Sqn.); S/L. W. H. Thallon (O.C., 617 Sqn.); and F/L. Morley (O.C., Conversion Unit).

From these officers we learned that the most experienced pilots available—some of them ex-instructors—had been selected to fly the Canberras of No. 101 Sqn., but that those for 617 Sqn. were in no sense hand-picked. At present pilots are converted to the Canberra by a small unit on the station. Following a course of ground instruction, they gain experience on the Meteor 7 and then complete 15-20 hr solo flying on the Meteor 4. Their first flights in the Canberra are made with an instructor sitting alongside. (Although a dual-control trainer variant of the Canberra is believed to have been projected, no such machines are in R.A.F. service.) Early this year the first Canberra Operational Conversion Unit will be formed at Bassingbourn, in Hertfordshire, and a proportion of National Service pilots will be trained to fly the type.

The Canberra B.2 has a crew of three—pilot, navigator-plotter, and observer. The two last-named are to a large extent interchangeable, though it is usually the navigator-plotter who navigates the machine to the target with radar aids, and the observer who, near the target, takes up his position to aim the bombs. There is no signaller and no W/T.—the only radio is the pilot's V.H.F./R.T.

(*Continued at the foot of page* 61)

Left to right, S/L. W. H. Thallon, O.C. No. 617 Sqn.; G/C. N.C. Hyde, Station Commander; W/C. H. P. Connolly, D.F.C., A.F.M., W/C. Flying; and S/L. E. Cassidy, D.F.C., O.C. No. 101 Sqn.

FROM ALL QUARTERS

Hawker Siddeley Progress

COMPANY reports vary greatly in content, from bare financial statements to detailed reviews that are both informative and interesting. The Hawker Siddeley Group's report, due to be presented to shareholders on Wednesday last by the Chairman, Mr. T. O. M. Sopwith, C.B.E., Hon. F.R.Ae.S., was very definitely in the latter category.

It pointed out, *inter alia*, that the Hawker P.1067—which, incidentally, took nearly three times as many man-hours in building as did the Hurricane—would shortly be in very large-scale production, while the Sea Hawk was already in production, first deliveries to the Royal Navy being due this month. The new Gloster G.A.5 all-weather fighter bears the new R.A.F. designation of "multi-purpose fighter." The Meteor N.F.11 is giving good squadron service and, in Canada, the first CF-100s have been delivered. Both the Shackleton and the Ashton, continued the report, were giving great satisfaction, while the last of 11,650 Ansons would shortly leave Manchester. All this effort had, however, meant reduced priority for the Apollo and the Avro Canada Jetliner. We intend to make further reference next week to this unusually comprehensive statement.

Prototype Valiant Lost

LAST Saturday, January 12th, whilst flying in the vicinity of its base at Hurn, Hants, the Vickers-Armstrongs Valiant was destroyed following a fire in the starboard engine bay.

With the loss of this first prototype, the continued rapid development of an outstanding aircraft must inevitably suffer something of a setback. A joint statement by the Air Ministry and the Ministry of Supply says: "The destruction of the Valiant was caused by accidental fire in one of the engine bays. Fortunately, the aircraft had already completed sufficient test flying to show that it fully met the Air Staff requirements, and the accident will not therefore entail any changes in the plans for its production." A further joint statement, on Monday night, said that the fire occurred during re-lighting tests: a quantity of fuel which found its way into the rear portion of the wing became ignited, and "unfortunately there was no fire-detecting equipment aft of the engine." The statement added that the escape equipment, including ejector seats, operated satisfactorily.

G. R. ("Jock") Bryce.

This first Valiant bomber had done very nearly 100 hours' flying, and its trials had gone remarkably well. The second aircraft is fairly well advanced—in fact, it is said to be likely to reach completion within the next few weeks. Disappointing as it is that this fine aircraft should have been thus destroyed, it is fortunate that four of the five crew-members escaped. The captain, Mr. G. R. Bryce (who succeeded to the post of chief test pilot last July) was accompanied by Mr. J. N. Montgomery, Mr. Protheroe-Thomas, Mr. G. L. Holland, and S/L B. H. D. Foster, D.S.O., D.F.C. and Bar, a Bomber Command officer who was flying as second pilot. All five baled out, but S/L Foster succumbed to fatal injuries on landing.

Whilst the officer in the foreground holds a hand anemometer to register wind speed over the deck, Mr. Hosegood, Bristol chief helicopter test pilot, brings the 171 in for a successful deck landing (see news below).

Sycamore Deck Trials

A LITTLE over a month ago (December 10-11th) the Bristol 171 helicopter spent a couple of days aboard the light fleet carrier H.M.S. *Triumph*, so that some preliminary assessment could be made as to the machine's suitability for ship-based operation. The trials were arranged by the Royal Australian Navy.

That helicopters will in future become regular units of a carrier's aircraft complement can scarcely be doubted; but in operating rotary-wing types from carriers there are problems, and it was to measure the 171 against them that the trials were arranged. Bearing in mind the essentially preliminary nature of the trials, it is justifiable to say that the 171 behaved in an exemplary manner, and to that extent the tests were successful. One of the more troublesome features attendant upon operating a helicopter from a ship's deck is known as "blade-sailing"—the term given to the uncontrolled rise of the advancing blade of a slowly turning rotor in relatively high wind speeds before centrifugal force builds up sufficiently to discipline the blade to a normal coning angle. Despite the fact that the 171 rotor was started from rest in wind speeds of 35 kt gusting to 40 kt, there was no hint of blade-sailing.

In addition to exploring the way the helicopter behaved on the flight deck, operational flight trials were also made and, on one occasion, the helicopter was recalled from its "guard duty" position off the starboard quarter of the carrier adjacent to the bird-dog destroyer. It is worthy of record that the period between Mr. Hosegood (who was flying the 171) receiving the recall message over the radio until the helicopter was struck down into the hangar was but six minutes.

MULTI-PURPOSE FIGHTER is the new official category to which WD804, first prototype of the delta-wing Gloster G.A.5, seen here on its second flight, belongs. This, the second photograph released, shows features not apparent in the first, head-on view: the form of wing and tail surfaces, with their rounded tips; a moveable surface in the trailing edge of the tailplane; and the fairing for the anti spin parachute

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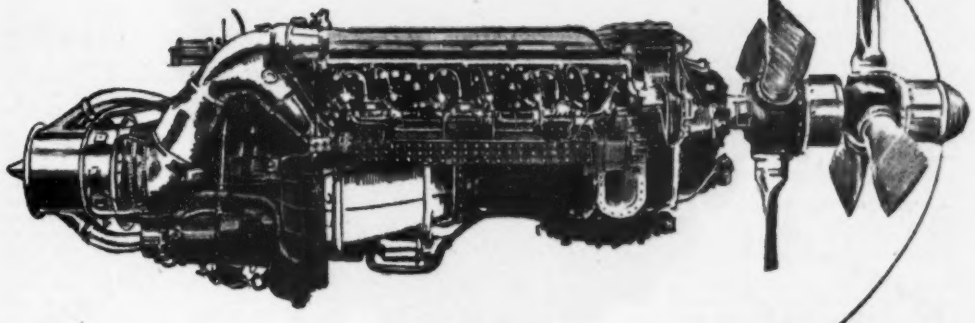

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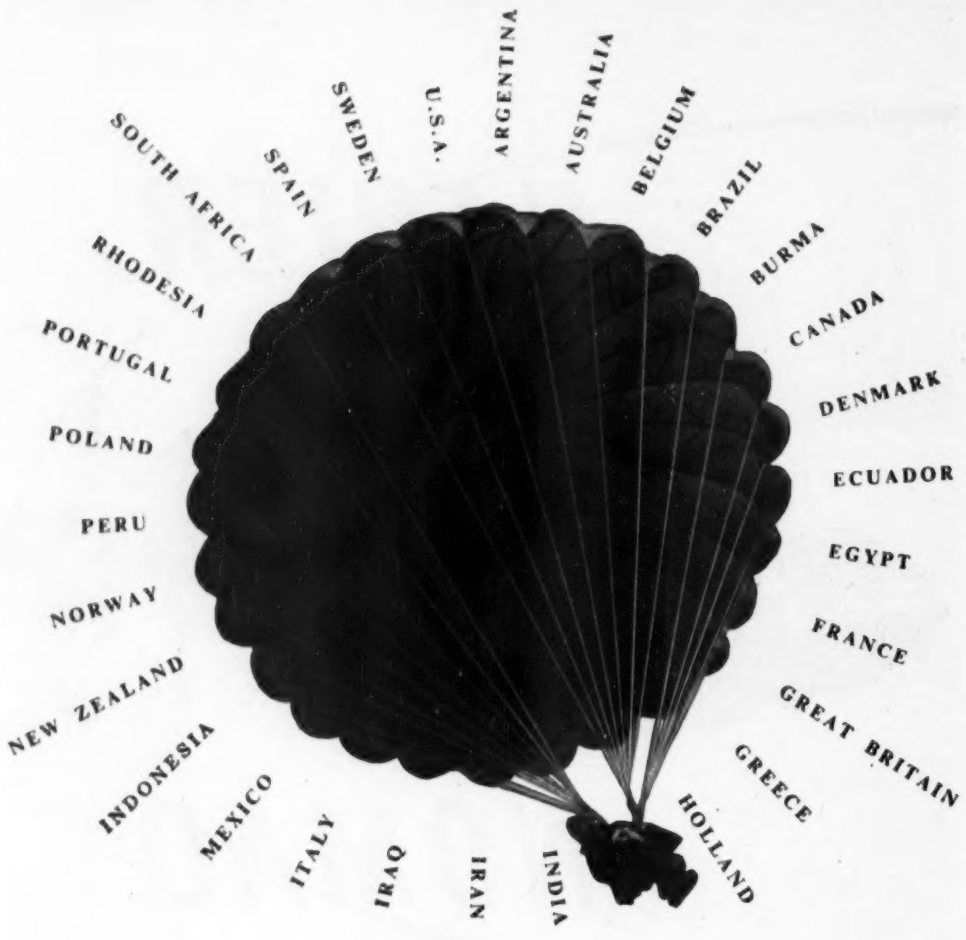

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THE CONTRACTORS' DINNER

THERE are not many occasions during the year when the eminents of the British aircraft industry are to be found gathered under one roof. The S.B.A.C. show provides one such occasion; another is the annual dinner with the Aircraft Contractors given by the Aeroplane and Armament Experimental Establishment, Boscombe Down. This is a rightly famous affair, where dignity and lightheartedness go hand in hand. Unavoidably postponed from December 7th, the dinner took place last Friday, January 11th, and had Hebe descended to grace the officers' mess at Boscombe that evening she would have been kept exceedingly busy; it was a memorable event.

In proposing the toast of the guests, the Air Commodore Commanding, A. Cdre. A. W. B. McDonald, C.B., A.F.C., observed that there were present that evening many people who had attended the dinners at Martlesham Heath a quarter of a century ago. He then went on to say that the Establishment had produced a greater number of reports during the past year than in any other peacetime year. As may be imagined, this was greeted with a thunderous outburst of derisory acclaim. Continuing, A. Cdre. McDonald said that the increased activity of the Establishment was a function of the increasing complexity of the work, and the increasing number of types resulting from the rearmament programme. The A. and A.E.E. was very proud of its independence (they could even claim independence from their own H.Q.); and although the contrary might sometimes appear to be the case, finding fault was not their main job; they took no satisfaction in it; in fact, they tried to be, constructive.

Individual firms were using Boscombe for their own tests to an increasing degree, and in this was included the Establishment's unit at Khartoum. A number of prototypes had made their first flights at Boscombe, where the runway facilities were now the best in the country; unfortunately, however, hangar and office space was not comparable in the same terms.

The reply to the toast was made by Sir Frederick Handley Page, who observed that just as many people had boasted that they were to dine with the Borgias, few people could have said they *had* dined with the Borgias—and the same thing could be said the following morning by those who had attended the Contractors' Dinner. Sir Frederick could remember the good old days at Martlesham Heath (he, too, had had beer poured down his trousers); and as more in keeping with the old spirit he suggested that some form of competition following these annual dinners should be inaugurated to symbolize the co-operative rivalry between the industry and Boscombe. Sir Frederick said that he would be pleased to present a trophy for a series of "proper" games to be conducted following the dinner, and in this connection suggested that a well-known frolic involving the employment of a potato might be tried for a start. More seriously, Sir Frederick felt that there was a warmth of welcome at these dinners which was not experienced anywhere else, but in conclusion he suggested that they ought to "forget all about those —— reports."

In proposing the toast to the aircraft industry, Air Marshal Sir John N. Boothman, K.B.E., C.B.E., D.F.C., A.F.C., spoke of matters which cannot well be reported in these pages. As always, his speech was humorously pointed, and was deservedly well received. Sir John did, however, observe that the industry had no financial recognition for valour: it had done the most amazing things, and had given us the finest aircraft in the world.

Replying to the toast, the President of the S.B.A.C., Mr. W. T. Gill, said that he was speaking on behalf of a "co-op"—the engine manufacturers. Today, we had to concentrate our technical manpower where it could best be used. The best things had come out of the industry under the chill wind of adversity; it was a pity, but none the less true. Referring back to the matter of the Establishment's reports, he said that they might be unpalatable but, even so, the industry would swallow them and would put them to use in producing better aeroplanes and good weapons.

B.O.A.C.'s FIRST COMET

THE first production Comet for B.O.A.C. was expected to be delivered to London Airport this week. It is, in fact, No. 5 Comet and No. 3 of B.O.A.C.'s allocation. Fully furnished and ready for operation, it will undergo brief acceptance trials and then await the paper work necessary for the issue of its C. of A.

During a recent inspection of the Comet production line *Flight* was agreeably surprised to see what good progress is being made. No. 18 fuselage is already in an advanced state. Not far away, incidentally, Nos. 3 and 4 Herons were also coming along well.

After completion of the first twelve aircraft, Series 1A Comets will start to come off the line. These will have additional tankage up to a total of 7,000 gal. Ghosts equipped for water injection will also be coming through in a few months' time. There are, at present, firm orders for 38 Comets and options are held for a number more.

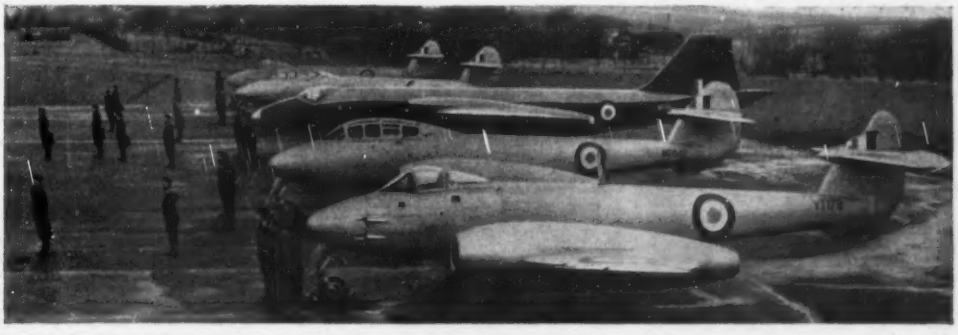
Looking to the future, it seems probable that the development limits of the Comet airframe will be in the region of 520 m.p.h. for cruising speed and 120,000 lb for a.u.w. The Series I will look after stage-lengths of 1,500-1,750 miles, and the Series II those of 2,250 to 2,500 miles.

It has been decided that Series II Comets will be capable of handling the 2,395-mile stage between San Francisco and Honolulu. Fortunately the weather, particularly into Honolulu, is very reliable, and thus reserves are not so critical as on most world-route stages.

CANBERRA in SERVICE (Continued from page 59)

For protection from glare at extreme heights Canberra pilots at Binbrook are testing a new type of vizor, which is found to be more convenient than tinted spectacles as it can be adjusted so that the eyes can be shaded from glare above while at the same time the pilot is not hampered in reading his instruments. All Canberra aircrew wear pressure waistcoats, which are coupled to the aircraft's oxygen supply so that, in the event of a failure in cabin pressurizing, the waistcoat can exert a steady pressure round the lungs to counterbalance the sub-normal external pressure.

W/C. Herbert, whose experience is unusually long and varied, has nothing but praise for the maintenance and servicing qualities of the Canberra and its power plant: in his own words, he has never found a better aircraft. He told us that No. 101 is one of the first R.A.F. squadrons selected for intensive flying trials of an entirely new character and it is understood that similar trials will be made with all future types introduced into R.A.F. service. The Canberras of 101 Sqn. are being flown at two or three times the normal peace-time intensity in order to gain as rapidly as possible a reliable indication of operational potentialities, and bearing in mind this intensive flying and the fact that the Canberras are being used for conversion and training, the Wing Commander's remarks are particularly significant.



The Conversion Unit at Binbrook. Its aircraft comprises one Canberra, two Meteor 7s and two Meteor 4s.

THE PROBLEM of how to run a 1,280ft power cable across a wooded valley in the Malvern Hills without damage to the trees was solved, on January 8th, by the charter of a Hiller 360 helicopter from Pest Control, Ltd. A light line, reeled out from a drum on the aircraft, was caught and secured by men on the pylon and was then used to pull across a steel cable, which was in turn employed to draw over the first of the steel-cored aluminium conductors. The operation was performed successfully, in a 20-kt cross-wind, by Mr. Jimmy Harper, Pest Control's chief pilot and aviation manager.

Impasse

COMMUNIST desires to proceed with airfield construction after a Korean armistice was signed continued, last week, to be one of the major stumbling-blocks in the truce negotiations at Panmunjom.

£94,600 Radar Awards

ON Monday last the Royal Commission on Awards to Inventors announced tax-free grants of £94,600 to scientists responsible for radar development; £50,000 of this sum goes to Sir Robert Watson-Watt, F.R.S.

Auspicious Inauguration

ON the first day of its service trials in Korea, one of the de Havilland Canada Beavers ordered by the American Army picked up a seriously wounded South Korean soldier and flew him to a base hospital for an urgent operation. In its U.S. Army co-operation rôle the Beaver is known as the L-20.

B.O.A.C.'s "175" Order

IT was announced last Tuesday that B.O.A.C. has "decided to exercise its contractual right" to take up the full number of 26 Bristol 175 (or Britannia) airliners, including one prototype. Previously, by agreement, work had been started on the first 15 aircraft only. The first of the two prototypes ordered by the M.o.S. is due to fly this summer and deliveries are planned to begin in the spring of 1954. There are also important negotiations for export sales.

Helicopter and Delta Amendments

TWO references made in our columns last week to new aircraft call for addenda. In the first place, the statement that the Bristol 173 was the world's first twin-engined, twin-rotor helicopter to have flown was not literally true, for there are both U.S. and Russian designs in this category. Both these types, however, have two engines driving two rotors independently: what we intended to imply was that the "173" was new in having two rotors either of which could be driven by one engine in the event of failure of the other engine—in other words, it is the first helicopter offering what is commonly known as "twin-engined safety." The second amendment concerns the Saab-210 delta, the unofficial name of which—*Draken*—should be translated not as "Dragon" but as "Kite."

HERE AND THERE

Commercial Air-Racing

NO fewer than 180 air races, many of them international, are planned by an organizing company formed recently in Paris under the title of Les Courses Aériennes. The Aero Club of Paris will co-operate. A team of eight Fouga Cyclones is being built with a view to participation in the contests, which will follow the pattern of the U.S.A. Goodyear Racer.

Another A. and A.E.E. Affair

ON the previous page we report the annual "Contractors' Dinner" at Boscombe Down. An associated function had taken place earlier, when, on January 2nd, the aircraft contractors' technical representatives at the A. and A.E.E. met at the High Post Hotel, near Amesbury. The Avro representative, Mr. W. Gilmour, welcomed the guests, who included A. Cdre. A. W. B. McDonald, C.B., A.F.C. and W/C. W. J. Barnard, O.B.E., from the R.A.F., and Messrs. J. Hanson and F. H. Beer from the M.o.S.

New Luftwaffe?

A TACTICAL Air Force of 75,000 men, "with the most modern jet fighters," will form part of Germany's contribution to joint European defence, according to Herr Blank, German Defence Commissioner and delegate to the talks on the Pleven Plan.

Handling Production

"GREATER output at lower cost" will be the theme of the Third Mechanical Handling Exhibition and Convention, to be held at Olympia, London, from June 4th to 14th. Some 170 firms will display their products on a quarter of a million square feet of floor space.

Costly Aberration

AN incident last November, when two Tasman Empire Airways flying-boats had to return to Sydney with engine trouble, has been found to be due to the fact that an oil drum was wrongly marked, in America, as containing engine lubricating oil. Total cost of the mistake, including stripping eight engines and the charter of substitute aircraft, is estimated at £200,000.

IN BRIEF

THE chairman of the Dunlop Rubber Co., Ltd., Sir Clive Baillieu, recently left for South Africa on a two-month business tour.

* * *

Geo. Salter and Co., Ltd., of West Bromwich, announce that Mr. G. A. Adams, formerly Coventry and East Midlands area manager, has been appointed sales manager of the company's spring division. His former post is being filled by Mr. W. N. T. Bearder.

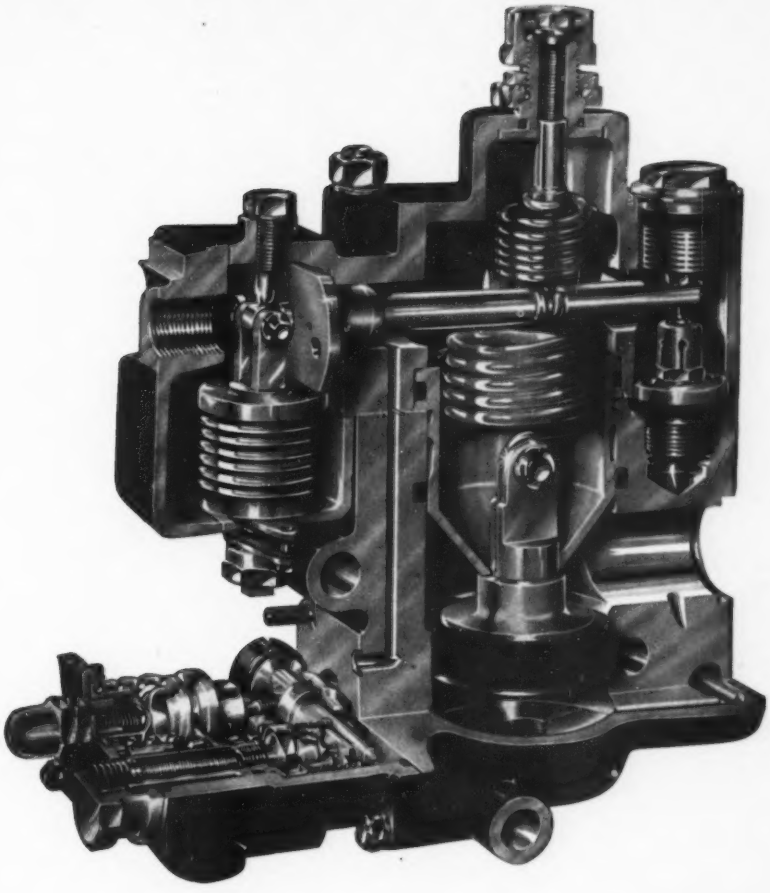
* * *

In a recent reference to the appointment of directors of E. K. Cole, Ltd., it should have been made clear that the executive who was largely responsible for the company's change-over to peace-time production after the war was Mr. F. S. Allen, M.I.P.E.

* * *

Coincident with the granting of A.R.B. approval to the new radio test house and laboratory of Aerocontacts, Ltd., at Gatwick Airport, Horley, comes the release of the firm's *Aero Radiologue*, in which are illustrated descriptions of the most commonly used British and American civil radio equipment, together with notes on delivery delay, if any, from stocks.

SECOND SAVAGE: This new version of the North American AJ-1 Savage carrier-borne heavy attack aircraft is officially designated XA2J-1 and is powered by two Allison T-40 turboprops in place of the two P. and W. R-2800 piston engines. The officially approved caption to the photograph makes no reference to the Allison J-33 turbojet installed in the earlier version. The maximum bomb load is over 10,000 lb and gross weight more than 26 tons.



This gas turbine fuel system control unit relates fuel delivery to air mass flow through the engine, thereby controlling engine accelerations at all altitudes, thus limiting the combustion temperatures.

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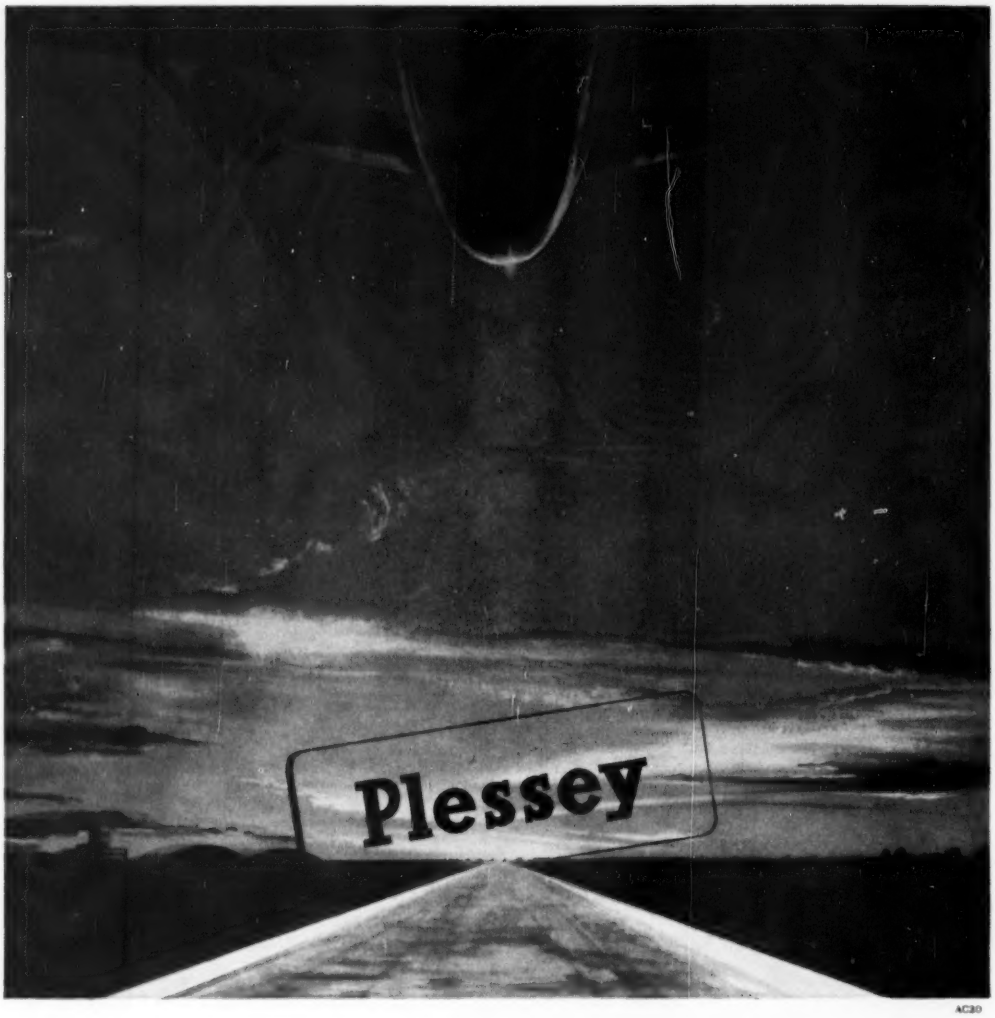

AC20

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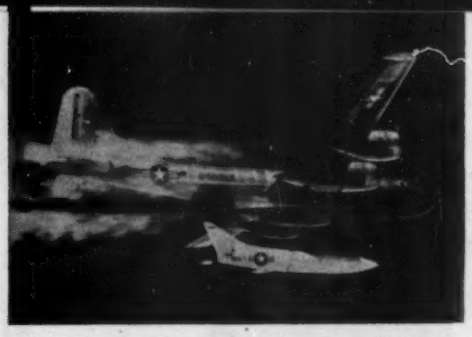


"Flight" photograph

(Left) *July: The Douglas Skyrocket flew at over 1,250 m.p.h.* (Right) *August: The Italian Ambroni S.7 was air-tested by the Editor.*

AIR YEAR REVIEWED

Part II: 1951 Events From July to December

LAST week we reviewed the aeronautical high-spots of 1951, from January to June, and on this and the next two pages the story is carried through to the end of the year.

July opened with a Royal occasion, when H.R.H. Princess Elizabeth accepted an invitation to be Hon. Air Commodore of No. 603 (City of Edinburgh) Squadron.

New Soviet swept-wing fighters appeared at the big annual display at Tushino on the 8th, watched by 250,000 people.

On July 3rd it was announced that the Douglas Skyrocket had flown faster than any other piloted aircraft, at over 1,250 m.p.h. A B-29 which landed at Marham on the 4th was the seventieth to be delivered to the R.A.F. under the mutual defence programme. On the 15th, nine R.Aux.A.F. squadrons completed their three months' training and were relieved by the remaining 11. The Australian Aux. A.F. received their first Nene-Vampires.

The Royal Aero Club's Golden Jubilee was celebrated, with the assistance of the *Daily Express*, by the three-day "Fifty Years of Flying" Display at historic Hendon Aerodrome and by an international rally at Gatwick. Other displays included those at Bristol (where Ron Paine, Hawk Speed Six, won the Bristol Air Race at 193 m.p.h.) and at R.N. Air Station St. Merryn.

Five Lincolns from the R.A.F. Flying College, Manby, made an Arctic training flight, one crossing the Pole.

On July 2nd, after 31 years' service, Capt. J. Laurence Pritchard retired from the R.Ae.S. secretaryship, and Dr. A. M. Ballantyne took over.

On July 19th the Airship Club's little dirigible *Bournemouth* made its first flight at Cardington, and at about the same time the Avro 707A delta took the air at Boscombe Down. From Australia came confirmation that Avons were to be installed in F-86s built under licence by Commonwealth Aircraft.

M.C.A. figures showed that the two Corporations' traffic for the year ended March 31st had increased by 33 per cent. as compared with the previous year. B.O.A.C. made its first quarterly profit. Members of *Flight's* staff flew in the Brabazon.

Thirty-three teams competed in the National Gliding Contests at Great Hucklow.

Mr. W. E. W. Petter succeeded Mr. H. P. Folland as managing director of Folland Aircraft. Capt. "Mutt" Summers, Vickers' chief test pilot for 22 years, retired from active flying.

On July 17th Mr. Igor Sikorsky lectured to the Helicopter Association on "Helicopters in Peace and War."

Notable articles in *Flight* included *The Story of the R.Ae.C.* (B. J. Hurren) and *Fifty Years of Flying* (J. W. R. Taylor). On the 13th we published the first photograph of Russia's new twin-jet bomber, confirming a drawing reproduced on May 25th.

August.—On the 3rd, we were able to reproduce photographs of the Hawker P.1067 and to announce that it had been ordered, "off the drawing-board," for the R.A.F. Soon afterwards, we were permitted to disclose that the Supermarine Swift F.1 had made its first flight, at Boscombe Down, and that the Short S.A./4 bomber had flown, on August 10th, at Aldergrove. On August 22nd, the Navy's first Attacker Squadron, No. 800, started forming. In our last issue of the month we described the private-venture Boulton Paul P.119 jet-conversion trainer.

To return to the early part of this eventful month, between the 1st and the 6th the first of the Canberras for the R.A.A.F. was flown to Australia by W/C. D. R. Cuming. At about the same time, in Korea, No. 77 Squadron, R.A.A.F., were just going into action with their new Meteors after a year of fighting in which they had flown 3,872 operational sorties.

On August Bank Holiday another major air race—the *Daily Express* South Coast event—was washed out by the weather.

The Standard Motor Co. announced acceptance of an M.o.S. invitation to build Avons. Other news from the industry included the appointment of Mr. D. L. Hollis-Williams, late of Fairey's, as Westland's chief engineer.

In air transport, B.O.A.C. Comet development flights, as far afield as Calcutta, had continued steadily and without incident; on August 15th B.E.A. put one of its Dart-powered Dakotas into service on the Northolt-Hanover freight run; at its maker's works a Dart completed a 500-hr test under simulated operational conditions

Another famous helicopter constructor came from America to lecture to the Helicopter Association—Mr. F. N. Piasecki.

America aimed high: on August 7th a Viking rocket ascended 135 miles from White Sands, Mexico; and it was disclosed that Maj. Bill Bridgeman, launched from a bomber at 35,000 ft, had climbed in the Douglas Skyrocket to a height exceeding the "absolute" record of 72,394 ft.

The month ended with notable records for this country: on the 31st W/C. R. Beamont flew a Canberra from Aldergrove to Gander at 480 m.p.h., and on the same day a Sapphire-Meteor (F/L. R. B. Prickett) established four time-to-height records, climbing to 12,000 m (39,372 ft) in 3 min 7 sec.

Two air tests appeared in *Flight* during August—of the D.H. Heron and the Italian Ambrosini S.7, and among special contributions was an article by J. R. Ewans, Avro's chief aerodynamicist, on *Aerodynamics of the Delta*.

September.—Always a month of climax in the British aviation calendar, September 1951 broke all previous records by virtue of the fact that four important aeronautical conferences coincided with the holding of the S.B.A.C. Display and Exhibition.

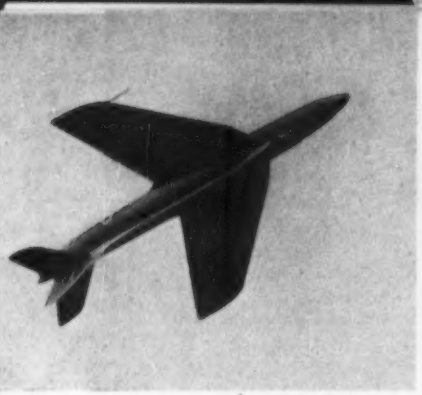
As ever, the Farnborough event exceeded expectations. Though there were few sensational last-minute surprises, all the new aircraft which had made their first flights during the preceding months were demonstrated, with only one exception—the Vickers-Supermarine Swift, which had been slightly damaged in a belly landing; but the massive twin-Avon Supermarine 508 duly arrived and was impressively flown by "Mike" Lithgow. Announced only a few days before the show, the Hawker P.1072—a P.1040 derivative boosted with A.S. Snarler rocket motor—was shown, but did not fly. Altogether, 51 aircraft were displayed and/or demonstrated. Among newcomers in the smaller categories were two new Austers, the Ambulance/Freighter and the A.O.P. Model S.

High-spots of the five days of flying were, by common consent, Neville Duke's sensational low-altitude passes in the Hawker P.1067, Zurakowski's presentation of a new aerobatic evolution, the "cartwheel," in the P.V. Gloster Meteor carrying 24 rockets under its wings, and W/C. Falk's exposition of the delta-wing Avro 707B.

At the S.B.A.C. Show Dinner in London on the 11th, guests from 70 different countries were entertained. The first fortnight of the month, in fact, saw an unprecedented influx of foreign visitors, largely by reason of the conferences mentioned above. One hundred and sixty delegates from 40 member-nations attended I.A.T.A.'s seventh annual general meeting, opened in London by the Prime Minister on the 10th; 500 delegates, British and American, heard 20 papers read at the third Anglo-U.S. Conference of the R.Ae.S. and I.Ae.S., held at Brighton; 63 scientists interested in space travel, from nine countries, gathered in London for the International Congress on Astronautics; and there was one all-British affair, the annual meeting of the Aerodrome Owners' Association.

On the 10th, Mr. A. E. Raymond of Douglas Aircraft delivered the 39th Wilbur Wright Lecture to the R.Ae.S.—a stimulating paper entitled *The Well-tempered Aircraft*.

News from Korea indicated that the pace of the air war was



(Left) At Farnborough, in September, the P.1067—here seen inverted—was brilliantly demonstrated by Neville Duke. "Flight" photograph

(Right) H.R.H. Princess Margaret receives from Lord Brabazon a presentation copy of "Fellowship of the Air" at the R.Ae.C. Jubilee Ball in September.

AIR YEAR REVIEWED . . .

increasing. There, on September 20th, occurred the first use of helicopters in an assault rôle, twelve S-55s being employed to transport a company of infantry to a strategic position. It was reported, too, that the aircraft of H.M.S. *Glory*, within three months of relieving H.M.S. *Theseus* in Korean waters, had made 3,000 deck-landings.

Major air exercises were held on the Continent and over this country. From September 14th to 23rd, in Exercise Counter Thrust, the British Army of the Rhine co-operated with, and/or were opposed by, aircraft of B.A.F.O. (which, on the 1st of the month, had reassumed the honoured title of 2nd Tactical Air Force) and five Western Union air forces. A few days after these operations were concluded, Exercise Cirrus got under way, running through into October: this was a purely air affair, in which no fewer than 1,000 aircraft of eight nations participated. Simultaneously, Exercise Pinnacle was held by Fighter Command to test the air defences of this country.

During the first week of the month it was announced in Washington that an order had been placed with Consolidated Vultee for the airframe of an atomic-powered aircraft; that General Electric had received a contract for the development of a power unit was already known.

On the 26th, 24 F-86s came to this country to complete the U.S.A.F.'s Sabre Wing here. At about this time it was announced that the first pilotless-bomber squadron would form in America on October 1st, the existence of the B-61 Matador being revealed.

Apart from aircraft appearing at Farnborough, first photographs of several new types appeared in our pages: for instance, the Bristol 173 helicopter emerged for its ground-running trials, and the D.H. 110 two-Avon all-weather fighter made its first flight on September 26th. Early in the month it was announced that the Percival Prince had been introduced into the R.A.F. under the name of Pembroke.

Rain interfered with several flying displays during September: it caused the abandonment of the Battle of Britain fly-past over London on the 15th, but did not prevent displays being held at 66 R.A.F. stations; earlier in the month R.N. Air Stations Gosport and Lee-on-Solent had carried through a show in wretched weather. Conditions were rather kinder for a large-scale display by R.N. Air Station Ford, when No. 800 Squadron's Attackers made their public bow.

At the second try, on September 22nd, the *Daily Express* South Coast Race was lucky with the weather: H. M. Kendall (Chilton) scored a runaway victory at 129 m.p.h. over the handicappers and 60-odd competitors. There were few other events in sporting flying during the month, but on the 3rd the clubs had got together for the annual A.B.A.C. Convention at White Waltham.

In commercial aviation, apart from the I.A.T.A. meeting, there was good news from B.O.A.C., who were able to announce that their July operations had shown the best month's profit yet—a surplus, after payment of interest on capital, of £122,000.

On the 1st of the month the B.O.A.C.-M.o.S. Comet (Capt. A. Majendie in command) reached Karachi from London in 13 hr 13 min elapsed time.

There were various developments in the industry. The Hawker Siddeley Group announced that three-quarters of the vast Hucclecote prefab-house factory was to be turned over to Sapphire production. The first of a number of Fireflies was handed over by Faireys to Ethiopean Air Force ferry-pilots. Mr. Attlee formally opened the 450-acre Esso refinery at Fawley.

Mr. F. M. Owner, formerly of Bristols, joined de Havillands as deputy chief engineer of their engine company, to which concern, also, Mr. W. F. Shaylor (late of Airspeeds) went as commercial manager. Mr. N. Rowbotham was compelled by ill-health to give up active duty as managing director of Bristols' engine division, and Handley Pages lost a valued executive by the death, on September 15th, of Mr. James Hamilton, their works director.

So far as *Flight* was concerned, most of the notable features during the month were concerned with Farnborough. Among presentations in the September 7th special issue were six pages of "British Aircraft to Scale," and a colour feature on the interior decoration of the B.O.A.C. Comets. On September 14th we published a detailed description of the new Slingsby Sky sailplane, and an air test of the Percival Provost, while in the same issue W/C. Charles Gardner told the story of an eventful flight (in which he had participated) by a Coastal Command Sunderland to evacuate a naval scientific-exploration party from Greenland. In the issue of the 21st, Mr. B. S. Shenstone, chief engineer of B.E.A., compared the Corporation's utilization record with some striking Australian figures that had recently been published.

In the final issue of September appeared a photograph with associations that reflected the anxiety which had suddenly swept over Britain and the Commonwealth at that time. Showing the King and members of the Royal Family with Canadian air cadets who had visited Balmoral, it had been taken only a few days before His Majesty returned to London for his serious operation.

October.—Further large-scale air exercises took place during this month. "Cirrus" and "Pinnacle," which had started during the last week in September, were shortly followed by "Surprise Packet," in which the R.A.F and Naval Aviation in this country, assisted by 2nd T.A.F., played a part in the Army's autumn manœuvres; then Coastal Command held Exercise Assess, in two phases and over 400,000 sq miles of the North Atlantic.

B.O.A.C. had the honour of carrying T.R.H. Princess Elizabeth and the Duke of Edinburgh to Canada on June 7th, in a Stratocruiser commanded by Capt. O. P. Jones. During their subsequent tour of the Dominion, the royal couple travelled extensively in an R.C.A.F. Canadair C-5. At about this time, incidentally, the R.C.A.F. formally took delivery of its first CF-100.

The R.A.F. did valuable service when the Egyptian trouble assumed serious proportions, its Hastings aircraft ferrying troops to Suez from both Cyprus and England. No 101 (B) Squadron had begun to receive Canberras. Air Chief Marshal Sir James Robb made a "retirement flight" in his personal Spitfire 16, 35 years after he had made his first solo at C.F.S.

It was announced that "a certain number" of Meteor N.F.11s were to be supplied to Belgium; we described the "V.I.P." Hastings, four of which had been delivered to the R.A.F.; and on the 9th the 1,000th aircraft to be completed at the D.H. Chester factory—a Chipmunk—emerged.

On October 4th a mission of S.B.A.C. members, accompanied by several senior officials concerned with aircraft supply, travelled to America to study production methods there. At home, in the supply departments and aircraft industry, a number of appointments and re-appointments were made: the M.o.S. announced that Mr. S. S. C. Mitchell had been appointed to the post of Controller of Guided Weapons and Electronics, whose previous occupant, Air Chief Marshal Sir Alec Coryton, had been released in order to join the Bristol Aeroplane Co. in a senior executive capacity; Mr. N. C. Robertson of E. K. Cole, Ltd., undertook duty in the new post of Director-General of Electronics; and Capt. R. T. Shepherd, Rolls-Royce chief test pilot, retired from active flying duties, to be succeeded by W/C J. H. Heyworth. It was announced, also, that at the end of the year Mr. N. E. Rowe, B.E.A.'s controller of research, would join Blackburn and General Aircraft as technical director.

In air transport, the month opened with a London meeting of Commonwealth officials to discuss jet airliner route problems. A statement on B.E.A. finances revealed a profit of £106,206 for the first five months of the financial year, with a 28 per cent increase in traffic. B.O.A.C. reported their profit for the first half of the financial year as £974,000, leaving a surplus, after payment of interest, of £133,000. On October 15th, B.E.A. increased fares on a number of routes; on the 21st Aer Lingus made reductions. The M.o.S./B.O.A.C. Comet, on October 10th, went from London to Singapore in a flying time of 19 hr 8 min; and C.P.A.'s Comet plans were announced. A.V-M. Sir

(Left) November: the opening of Entebbe Airport, Uganda. "Flight" photograph

(Right) December: first pictures of the Gloster G.A.5 were published.

Leonard Izitt, R.N.Z.A.F. ret., delivered the British Commonwealth and Empire Lecture to the Institute of Transport, speaking on *Air Transport in New Zealand and the South Pacific*. On the 25th, Japan inaugurated her first post-war air service. On October 14th, the death occurred of Col. A. M. Miller, a pioneer of Service and civil aviation in South Africa.

On the 29th, the R.Ae.C. held its Jubilee Ball, graced by the presence of Princess Margaret.

Among articles which we published during October was No. 2 of the "Throttle Benders" series, about Nat Somers, while the Editor described an unconventional trip, in *Flight*'s Gemini, to a rally in the South of France.

The month ended with the emergence (on the 30th) of the first Saunders-Roe Princess from her assembly hangar and with the announcement of the names of a number of Ministers appointed by the new Government, including Lord De L'Isle and Dudley (Air), Mr. J. S. Maclay (Transport and Civil Aviation) and Mr. Duncan Sandys (Supply).

November.—The increasing tempo of the air war over Korea was again emphasized this month, by battles comparable in numbers of aircraft—as one observer put it—with those over Britain and the Continent during World War II. Summing-up results since fighting began, Gen. Vandenberg put the number of Migs destroyed at 99, with 20 probables and 239 damaged.

In a notable speech in London on November 1st, Air Chief Marshal Sir Guy Garrod drew attention to our present and potential aircraft production and the man-power situation in the factories. On the 5th, the fifth of a series of atomic bomb tests in Nevada was conducted with the aid of a B-29. On the 28th, the first eight-jet Boeing XB-52 bomber emerged.

Forty-eight F-86s of No. 410 Squadron, R.C.A.F., arrived in this country in the Canadian carrier *Magnificent*, and the first shipment of Douglas Skyraiders for the Royal Navy also arrived. On the 15th, No. 1 Fighter Wing, R.C.A.F., ceremonially took over from the R.A.F. the airfield at North Luffenham. On the 22nd, the first of a number of Bristol Freighters ordered by the R.N.Z.A.F. left on its delivery-flight. Eleven R.A.F. aircraft, including four Vampires, were engaged during the month on surveying a jet reinforcement route from South Africa to Suez. In our issue of November 30th a member of the staff gave his impression of trials made by the newly launched H.M.S. *Eagle*, Britain's largest aircraft carrier. On the 13th, the first three of a large order for D.H. (Canada) Beavers was delivered to the U.S.A.F.

On November 26th S/L. W. A. Waterton made the first flight with the delta-wing, Sapphire-powered Gloster G.A.5.

Rolls-Royce, Ltd., made an agreement—said to be worth nearly £9 million—to provide Nenes for Lockheed T-33 trainers to be built by Canadair.

Turning to civil aviation, the November record included the opening, on November 9th, of the reconstructed Entebbe Airport, at a key point on the African routes; news that Air France's order for Viscounts concerned 12 aircraft, valued at over £2 million; and Mr. J. S. Maclay's announcement, on the 22nd, of the "business clubs" private-flying concession.

When B.O.A.C. returned Comet G-ALZK to the M.o.S. after six months of operational development duty, it had made a dozen overseas trips and flown 470 hours. It was announced that the Canadian Government had ordered two Comets, though not (apparently) primarily for civil purposes.

On the 30th, the prototype Viscount 700 returned from two months of tropical trials.

On November 9th B.E.A. took delivery of their first Bristol 171 helicopter. From Brussels it was reported that Sabena's helicopter mail services in that area, operated for a year, had proved "highly encouraging," the two Bell 47-D1s having carried 50 tons of letters.

Mr. Ernst Ljungberg was named as the successor—taking office on January 1st—to Dr. Albert Roper, secretary-general of I.C.A.O. At a Paris meeting on November 14th-16th, the International Air Brokers' Association was formed. From Toronto came news that the Short Sealand was nearing the end of its 50,000-mile demonstration tour of the Americas.

Club activity had by now slowed down, but on November 3rd the Vintage Aeroplane Club was inaugurated at White Waltham.

An exceptionally large number of noteworthy features appeared in *Flight* during the month. Among them were a 40 years' history of the Sopwith/Hawker organization; an article on demonstration-flying by de Havilland's John Derry; an account by members of the R.A.F. Gliding Association of a visit to France to investigate the St. Auban "standing wave"; the story, by F/L. W. E. P. Johnson, of the beginnings of R.A.F. instrument-flying 21 years ago; and a two-part review of power-operated flying controls by R. Westbury, of H. M. Hobson, Ltd. A member of the staff went to France to sample several French private aircraft, and the same contributor tried out the Decca Flight Log in B.E.A.'s prototype H.P. Marathon; the third of the "Throttle Benders" series appeared, Tony Cole being the subject on this occasion; and John Yoxall secured some remarkable air-to-air pictures of formation aerobatics by No. 66 Squadron's celebrated Meteor team.

December—In her capacity of Grand Master of the Guild of Air Pilots and Air Navigators, Princess Elizabeth attended the Guild's reception on December 7th and formally installed the new Master (Mr. J. Lankester Parker) and other officers. Her Royal Highness also presented the Cumberbatch Trophy (for work enhancing airline reliability and safety) to B.O.A.C.'s No. 3 Line, and the Brackley Memorial Trophy to Capt. H. W. C. Alger.

The R.A.A.F. adopted the Commonwealth C.A.22 as its basic trainer.

On the 23rd, the four-man crew of a U.S.A.F. C-47, which had been forced down by Soviet fighters on to a Hungarian airfield on November 19th, were "tried" for "violating Hungarian territory" and fined £11,000 each.

Five more Fokker-built Hawker Sea Furies were delivered to the Royal Dutch Naval Air Service.

Just before Christmas, a second contract was awarded in Washington for the construction of a nuclear-power aircraft engine, this time to Pratt and Whitney.

Though in other respects December was comparatively uneventful, there were a number of developments in air transport. On the 5th, for example, a debate opened in the House of Lords, in the course of which Lord Leathers, Minister for Co-ordination of Transport, Fuel and Power, outlined Government intentions with regard to the Corporations and the independent operators. Shortly before Christmas, at an I.A.T.A. conference in Nice, over 100 representatives of 40 airlines of 30 nations reviewed world rates and fares, emphasis being placed on fare-reduction by means of non-luxury travel. Silver City Airways made a demonstration flight for their new Southampton-Cherbourg car ferry, and also announced that they had ordered six new "long-bold" Bristol Freighters, which will bring their Freighter fleet up to 14. From America came news that orders for the Super Constellation, lately approved at a take-off weight of 120,000lb, now totalled 67.

In our December 14th issue we described B.E.A.'s new "streamlined" administrative structure, and a week later we published their outline specification, to be circulated to the aircraft industry, for a large helicopter. In the same issue, the Corporation's methods of pilot-training were described.

On the last day of the year, there was news that official approval had been given the British Commonwealth Pacific Airlines for the ordering of six Series II (Avon) Comets for operation on the routes from Australia and New Zealand to America. The French Comet order (Union Aeromaritime de Transport) was increased to three Series I, with an option on Series II aircraft.

On December 17th, the Fifteenth Wright Brothers' Lecture (not to be confused with the Wilbur Wright Lecture) was given before the I.Ae.S. in Washington by Dr. P. B. Walker, Head of the Aircraft Structures Department at Farnborough.

An important technical development in America was revealed by Taylorcraft's demonstration at Pittsburgh, on December 6th, of the Custer wing, which permits hovering by a fixed-wing aircraft.

In our issue of December 28th we described the R.A.E.'s work on explosion-suppression devices for aircraft tanks.

Among industry appointments notified were the names of F/L. Massey-Hilton, as an assistant managing director of the Fairey Aviation Co. and of Mr. F. H. Pollicutt (formerly of Bristols) as chief designer at Folland Aircraft.

Notable articles published in *Flight* during the month included a series of three, by the Editor, on a visit which he had made to Africa to see the opening of the new Entebbe Airport and to fly on Sabena's routes in the Belgian Congo.

HELICOPTER HISTORY

Patents Reviewed in Lecture to Helicopter Association: Early Work on Jet Drives

TONIGHT, January 18th, Mr. L. H. Hayward, patents engineer to the Fairey Aviation Co., Ltd., is to present to the Helicopter Association of Great Britain a paper entitled "A Review of Helicopter Patents." The lecturer will review a number of historical experiments up to about the beginning of the century; thereafter, because helicopter patents are so numerous, he will confine his review to jet drive developments. By the courtesy of the author and his employers, we are permitted to publish this first instalment of the paper—taking the story up to the early years of the Second World War—in advance of its delivery.

LIKE so many other things, helicopters appear to have originated in China. Mr. Hayward's paper begins by mentioning that the Chinese had probably been making toy helicopters many centuries ago; these were usually a pair of feathers joined by a boss, which was then rotated upwards off a threaded stick (similar toys are sold today). The Chinese, however, did not leave any definite records of their experiments; the first person to do so was Leonardo da Vinci (1452-1519), the Italian scientist, artist and engineer. His illustrated reports showed that his basic theory was on the right lines, and all due credit should be accorded him as the inventor of the helicopter. Had some mechanical driving means existed, his helicopter might well have been capable of flight.

It was not until 250 years after da Vinci's death that anyone left record of having sought to improve upon his work. From 1768 onwards, however, helicopter designs appeared frequently, for man was now exercising his ingenuity to find a machine capable of flight. Very few of the models and machines that were built ever achieved flight, for in most cases no suitable power unit existed; many relied upon the physical exertions of the operator. Mr. Hayward's paper deals with a great many such projects, most of them of French origin; Fig. 1 is an 1860 example.

The next step brought us to England. Sir George Cayley (1773-1857), "the father of British aeronautics," experimented with airships, gliders and ornithopters and was universally accredited with the honour of having been the first person to design a full-size helicopter. He constructed many models, usually driven by clock springs or whalebone, and then proceeded to design a full-size machine which was to have been driven by steam power. A model of this design (Fig. 2) was built in 1843. The hull-shaped fuselage, designed to be amphibious, housed a small steam-engine which drove the two superimposed rotors by chains; the rotors revolved in opposite directions to balance-out torque, while for forward flight two small four-bladed pusher propellers were provided.

Mr. Hayward's paper then goes on to consider a number of other nineteenth-century helicopter projects, again mostly of French origin, although British experiments were beginning to become numerous. Rotors actuated by turbines were specified in an 1889 patent by J. Craig (Fig. 3): a steel tubular framework supported a basketwork car, and two tandem rotors, revolving in opposite directions, were shown connected to turbines operated by naphtha vapour generated in a large heated cylinder.

Two following patents (also British), embodied, in the first case (C. J. Walker, 1892) a built-in parachute to be opened "in the case of a very rapid descent," and in the second (Los Olivos, 1895) provision for a balloon to "assist in lifting the machine, if necessary."

Such extracts indicate that the early experimenters often visualized disaster. The lecturer, however, in concluding his first section, observes that these efforts, although probably causing amusement and speculation to the present-day student and designer, were to a high degree responsible for enabling the modern designer to produce a safe and efficient helicopter.

Mr. Hayward points out that the multiplicity of patents concerning helicopters in general makes it impracticable to review each one, and the main body of his paper is therefore confined to a survey of patents involving jet-driven rotor blades.

Among the early designs of this type, the author mentions an especially ingenious project by the Frenchman Heroult, granted a U.S. Patent in 1909. In this design, fuel supplied under pressure to a hollow rotor shaft was led through pipes within hollow blades to propulsive ducts at the tips. Air entered through intakes in each blade and was mixed with the fuel in the first part of the combustion chamber. The fuel-air mixture then passed along the chamber, expelling the burnt gases from the previous explosion, until it was itself exploded by an igniter. The exhaust gases then escaped from a flared nozzle at the tip of the blade. An oblique flap-valve automatically regulated rotational speed; the greater the centrifugal force, the more the valve tended to assume a radial position and thus hinder the escape of the propulsive gas. This arrangement was intended to balance the increase in combustion pressure caused by the increased centrifugal force at higher speed.

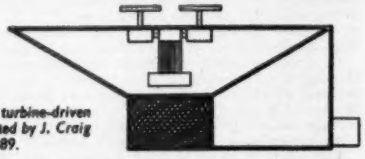


Fig. 3. The turbine-driven helicopter patented by J. Craig in 1889.

The grotesque machine illustrated in Fig. 4 was due to the Frenchmen Papin and Rouilly, who took out a number of patents for it in 1912. It was described as "an amphibious helicopter having a single balanced rotor, or a rotor made up from 2, 3 or 4 blades." In the single-bladed case, the engine was installed in a stub blade as a counterweight, but in other cases it was as near as possible to the machine's centre of gravity. Fuel and oil supply to the engine, being governed by centrifugal force, was proportional to the rotor speed.

Papin stated that the engine, which could be either a turbine or of reciprocating type, drove a suction fan delivering air along the rotor blades to orifices at the tips. Engine exhaust was admitted to the fan casing and also passed along the blades. The apparatus was stated to have been steered by cyclic pitch-change, rudder surfaces being provided if desired; this equipment was not shown in detail in the patent. There was also provision for autorotation.

A captive type of helicopter was the subject of a United States

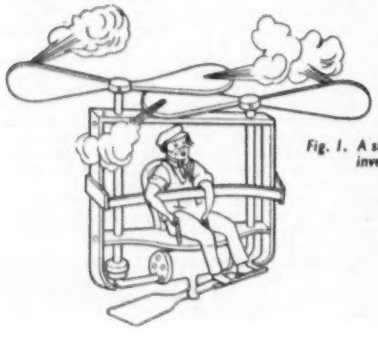


Fig. 1. A sketch by an unknown inventor of 1860.

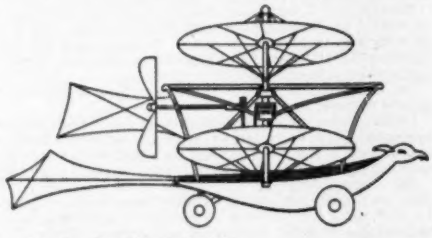


Fig. 2. Sir George Cayley's steam-driven helicopter of 1843.

Rolls-Royce
produce
turbo-jet,
propeller-turbine
and
piston aero-engines
to suit
all types of
medium
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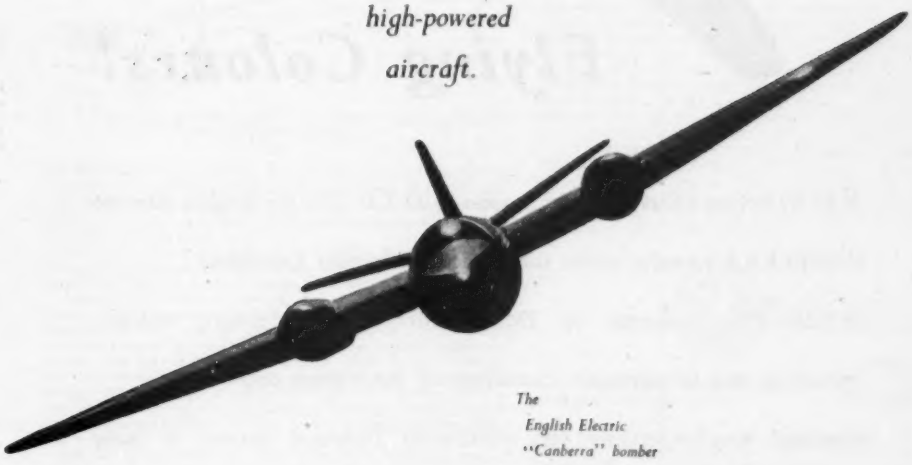

The English Electric "Canberra" bomber is powered by two Rolls-Royce "Avon" turbo-jet engines.

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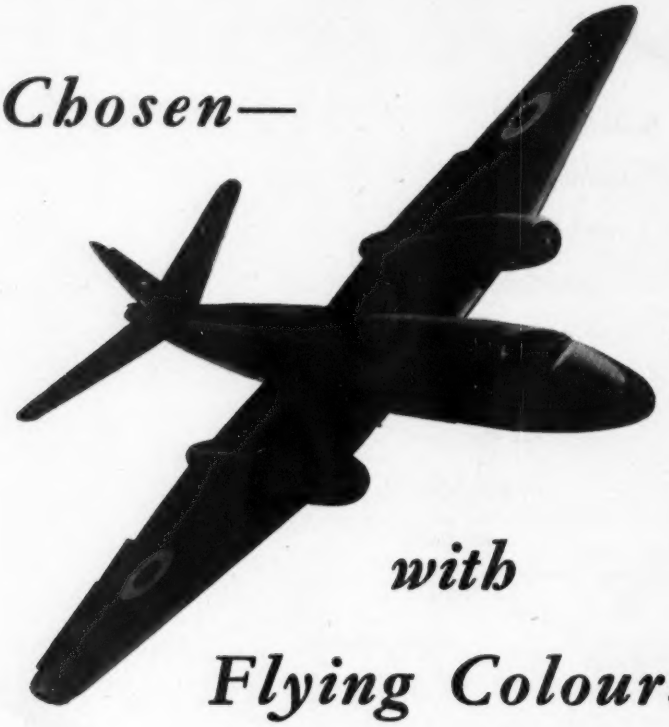

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HELICOPTER HISTORY . . .

patent of 1923. This machine incorporated rotors driven by compressed air, or gas, fed from a reservoir by flexible tubing. The patentee, one H. Ypma, stated that his machine would be of use in fighting fires in high buildings, and that to this end the rotors might be operated by a high-pressure water system.

The first jet-helicopter U.S. patent issued to Igor Sikorsky was dated 1929. The drawings, two of which are shown in Fig. 5, disclosed an amphibious machine having a jet-driven, tiltable rotor to provide forward thrust additional to that produced by two jet-operated tractor airscrews. These horizontally acting airscrews were symmetrically disposed in relation to the lifting rotor, so that by appropriate throttle control the rotor torque was effectively compensated.

Sikorsky stated that the driving medium might be air, air mixed with other gases, or any other convenient and practicable fluid. Air was pressurized by a pump or blower and was then expanded by the application of heat during its passage to the rotor or airscrew blades. These blades were provided with longitudinal jet orifices on the lifting side, near the leading and trailing edges. The operating fluid discharged under pressure from the trailing edge caused rotation of the blade, while that discharged from the slot near the leading edge not only assisted rotation but also performed a lifting function, being discharged towards the trailing edge across the "negative" or "depression" side of the blade.

This patent also included a diagrammatic layout of one embodiment of this system. A blower, driven by two internal-combustion engines *via* manually-operated clutches, delivered air to the rotor and airscrew blades either directly, or else through an expansion chamber or a heat exchanger. Engine exhaust gases were used to heat the air in the latter case.

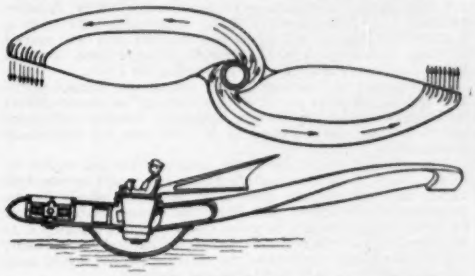


Fig. 4. The amphibious concept of 1912 patented by Papin and Rouilly, shown in its two-bladed form.

Mr. Hayward's paper goes on to describe a number of jet-helicopter patents of the early 1930s, among which were several English patents due to the German, Dr. Dornier.

Among Dr. Dornier's patents, dating from 1935, was one showing reaction units at the blade tips, rotatable about the blade's longitudinal axis; each jet nozzle was carried by a shaft which could be rotated by bevel gears from another vertical shaft concentric with the rotor axis. The vertical shaft normally revolved with the rotor, but upon its being displaced ahead of, or lagging behind, the rotor, motion was transmitted to the reaction units to vary their thrust-axes; in the extreme position, the reaction units could be turned through 180 deg, in which case a braking action was produced.

Another of the series of patents disclosed a windmill type of aircraft, in which one rotor was driven and a second rotor was either clutched to the driven rotor or allowed to windmill, as desired. A further Dornier patent showed a rotor arrangement in which a set of rigidly attached blades was driven by reaction jets, while articulated blades (which might be of different section, length or profile) on the same shaft were rotated by the driven blades.

In the same year (1935), a patent was filed by Bleecker in the United States featuring a small, self-contained ramjet having glow-plug ignition. The combustion chamber (Fig. 6) was provided with baffles in order to deflect the fuel-air mixture towards the centre of the chamber for igniting.

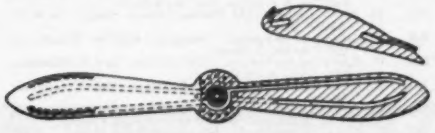


Fig. 5. Two sketches from Sikorsky's patent of 1929, showing the jet orifices arranged along both horizontal and vertical rotors.

A further 1935 patent mentioned in Mr. Hayward's paper was one due to the American, E. A. Stalker. With the relatively thin and narrow rotor-blades which appeared to have been more or less standard up to that time, it was quite natural to employ high-pressure jets for propulsion applied at the tips, since only a small duct was required to convey sufficient working fluid. Stalker was well aware of the difficulties of producing such a jet efficiently,

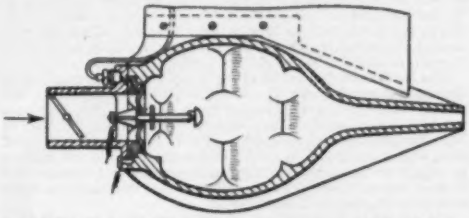


Fig. 6. Bleecker's ramjet of 1935. This was intended for blade-tip mounting. Baffles are shown in the combustion chamber.

apart from the fact that it was relatively inefficient after it had been produced. He stated that it was possible, with suitable combinations of blade form, nozzle shape and blowing means, to produce efficient low-velocity jets. To assist such a system, energization of the boundary layer on the rotor blades was employed. Guide vanes in the rotor head distributed air to the hollow blades, whence it issued from discharge slots along a substantial length of the blade span to energize the boundary layer and also propel the blade. Control blades fitted above the main rotor were provided to correct automatically any unbalance in the rotor system.

Again in the United States, a patent of 1939, in the name of the Autogiro Company of America, disclosed airscrews mounted at the rotor-blade tips. One form of this arrangement showed a system in which each rotor blade carried a contra-rotating airscrew, the forward blade assembly being mounted upon a shaft upon which the rear assembly was free to rotate. In this arrangement, fluid was delivered to jets arranged around the periphery of a ring in the plane of the forward airscrew and carried by the blade tips of that airscrew. A second ring was also provided, carried by the blade tips of the rear airscrew, and adjacent to, but behind, the first; the two rings together were of streamline cross-section. In the rear ring a number of impeller blades were arranged, so that energy in the jet, which would otherwise have been dissipated, was utilized to drive the rear airscrew.

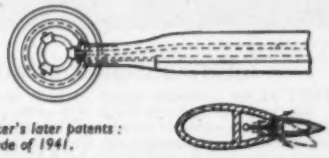


Fig. 7. One of Stalker's later patents: the flapped rotor blade of 1941.

Yet another United States patent mentioned in Mr. Hayward's paper was a further invention of E. A. Stalker's, filed in 1941. Drawings from the patent, reproduced in Fig. 7, disclosed a rotor blade incorporating a trailing-edge flap. Air delivered to the hollow blades passed along them until it flowed out to atmosphere through a slot formed between the main blade and the flap, the latter being provided with a mass balance within the blade. A feature was the cambering of the blade coincident with the opening of the slot to its greatest extent. The slot flow and the flap then co-operated to provide a lift increase greater than the effect of either alone. The flow issuing from the slot propelled the blade, and also provided a means of controlling it.

A British patent filed in 1942 by Weir featured a jet thrust to counteract the torque from a mechanically-driven rotor. The jet was provided by the engine exhaust and the cooling air heated by passing over the engine. The engine-driven cooling fan acted as a blower, while the engine exhaust was delivered to an auxiliary fan to raise the pressure in the jet, which left a reaction nozzle discharing at right angles to the fuselage centre-line. To vary the discharge, a control was provided for releasing the exhaust before it entered the auxiliary fan.

(To be concluded).

INDONESIAN-PILOT TRAINING

Initial Batch of 18 Students Arrive in the United Kingdom

LOOKING fit and eager, if a little disconcerted by the icy chill of what they were assured was a relatively warm winter's day, a contingent of 18 Indonesian pupil-pilots arrived at Southampton's Ocean Terminal on the morning of Wednesday, January 9th. Their intention (as recorded last week) was to join forces with students of some 21 other nationalities now undergoing instruction at Air Service Training, Hamble, in order to reach proficiency in various aeronautical activities.

The Indonesian pupils, all of whom are between the ages of 21 and 24, had mostly flown for about five hours on Piper Cubs, and during their three weeks' voyage from Djakarta they had been taught a little English. They were accompanied on the boat by Mr. Grandia, the Dutch Director of Civil Aviation in Indonesia, who, with his wife, will remain for a month or two in this country to supervise the initial training arrangements and organize the English lessons which will be necessary before the pupils are really able to settle down to their flying.

On arrival at Southampton, the students were entertained at a luncheon given in their honour by the directors of A.S.T. and presided over by the mayor of Southampton, Councillor Mrs. M. Cutler, O.B.E. During her address of welcome, the Mayor presented a beautifully bound copy of Southampton's war history to Mr. Ganis Harsono, a representative of the Indonesian Embassy. He accepted it on behalf of the President of Indonesia, to whom the gift will now be forwarded. A further message of welcome, from the Minister of Civil Aviation, was read (in the Minister's absence) by G/C. J. B. Veal, A.F.C., of the M.C.A.

A *Flight* representative managed—despite the language difficulties—to gather a certain amount of information from these shy but extremely keen young students. All of them are very eager to learn to fly in this country and—provided the necessary standard is reached—it is possible that a number may be staying behind after their initial 2½-year course to obtain Instructors' Ratings and assist in the training of future contingents.

It has been intimated that at least 75 pupils will undergo commercial training under this Government-sponsored scheme but it is not known whether all of them will come to this country. A further party of nine is, however, due to arrive shortly. Another batch of Indonesian pupils is already undergoing instruction at a school in California and, previously, students have been trained in India, Australia and the Netherlands. Most of these, however, have joined the recently-formed Indonesian Air Force.

On returning to their own country commercial-licensed pupils will undergo a further period of "line training" as second-officers on Dakotas operated by Garuda Indonesian Airways, a company which is now jointly owned by K.L.M. and the Indonesian Government.

The intention is that, ultimately, national pilots will replace all of the Dutch, Australian and American crews now serving with G.I.A. and the company itself is to be owned wholly by the Indonesian Government. It is likely that a considerable number of pupils will eventually be given marine aircraft experience, as existing Catalina operations are almost certain to be appreciably expanded. In this connection, the versatile Sealand would seem to be the only type both applicable and available.

In any event, large-scale expansion of Indonesian air routes is being planned as part of the industrial and cultural growth of this newly born nation and Air Service Training may take just pride in the fact that they will have been responsible for the early training of some of the future leaders of the country's rapidly growing air-transport industry.

Waiting to disembark at Southampton, some of the Indonesian students seem to be favourably impressed with their first glimpse of the country which is to be their home for the next 2½ years. On the extreme right is Mr. Ganis Harsono, the representative of the Indonesian Embassy.

NIGHT BOMBING IN KOREA

JUST as the Luftwaffe began 1945, so did the Communist bomber forces in Korea begin 1952—with a show of offensive strength after a period of inactivity. Communist bombing has so far not been worth considering, but there are indications that, having at last established a formidable fighter force, the enemy is now rapidly increasing his bomber strength.

The operations on January 1st, although on a small scale, were upon pinpoint targets (Kimpo airfield and the harbour at Inchon) and were made at night. Precision night bombing has certainly not been a Communist speciality in the past, and the U.N. Air Staff is likely to watch their progress in this field with more than academic interest.

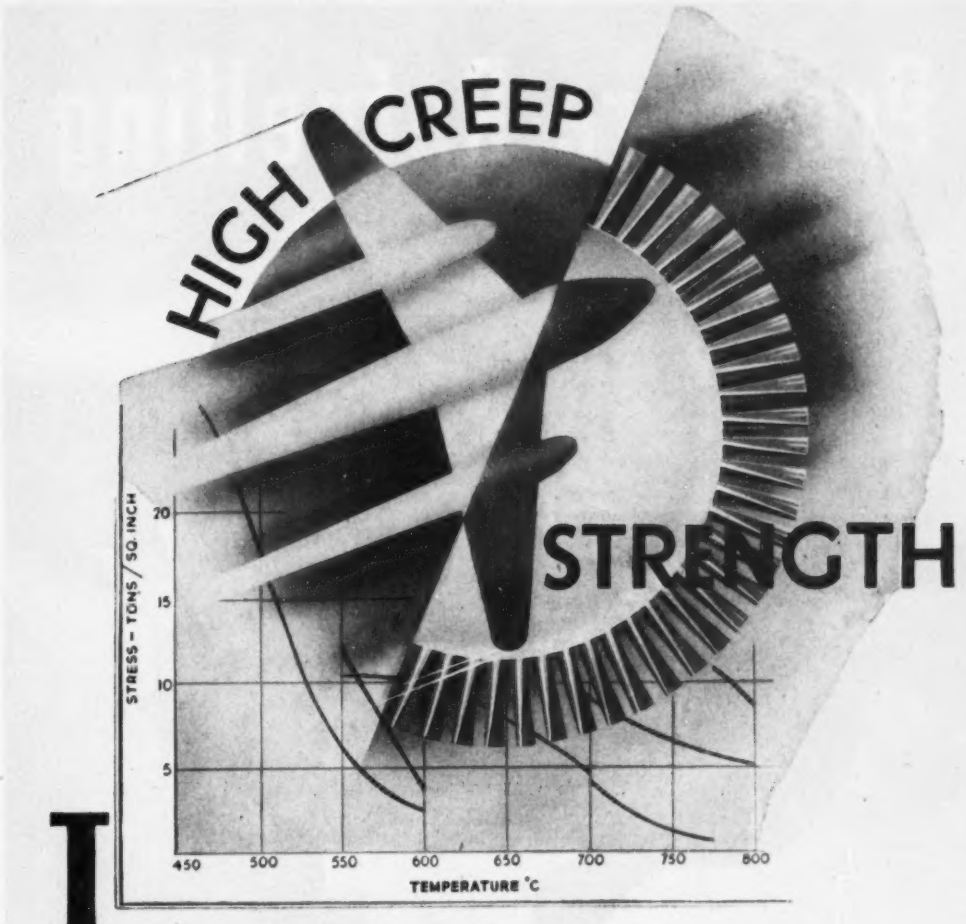
BRITAIN'S GLIDING TEAM

NOTICE of the forthcoming International Gliding Championships, to be held—probably in June—at Huesca, Spain, was given in our issue of December 21st, 1951. The British team has now been chosen and, for the third time, Mrs. Ann Douglas has been selected as captain and team manager. The flying team consists of F/L. R. C. (Jock) Forbes, the present national champion; G. H. Stephenson; and P. A. Wills, Lorne Welch and Frank Foster. The reserve will be David Ince.

This is probably the strongest British contingent ever to take part in an international gliding event and their chances will almost certainly be further improved by the fact that all its members will fly the new Slingsby Sky sailplane.

FORTHCOMING EVENTS

Jan.	18.	Helicopter Association: "A Review of Helicopter Patents."
Jan.	18.	Institute of Navigation: "Navigational Errors," by W/C. E. W. Anderson, O.B.E., D.F.C., A.F.C.
Jan.	19.	Aircraft Recognition Society: Hurricane Trophy Competition.
Jan. 19-20.		Vintage Aeroplane Club: Rally.
Jan.	22.	R.Ae.S. Graduates and Students Lecture: "Aircraft in Agriculture," by P. H. Southwell, Grad. R.Ae.S.
Jan. 28-Feb. 1.		Institute of the Aeronautical Sciences: 20th Annual Meeting, New York.
Jan.	29.	Society of Instrument Technology: "Mechanical Consideration in the Design of Servo Systems," by Prof. A. Tustin.
Jan.	31.	R.Ae.S. Section Lecture: "Problem of Short-haul Air Transport," by T. W. Brooks, B.Sc., A.C.G.I., A.F.R.Ae.S.
Feb.	7.	R.Ae.S.: "Availability and Use of Aeronautical Information" (Joint Discussion with ASLIB).
Feb.	11.	Institute of Transport: Brancker Memorial Lecture: "The Flying-boat and its Place in Aviation," by Air Chief Marshal Sir Frederick Bowhill, G.B.E., K.C.B., C.M.G., D.S.O.
Feb.	12.	R.Ae.S. Section Lecture: "Flight-test Problems for Civil Aircraft," by B. P. Laight, B.Sc., A.F.R.Ae.S.
Feb.	14.	R.Ae.S. Graduates and Students Lecture: "Radar," by B. W. Hodlin, B.Sc.
Feb.	15.	Institute of Navigation: "Navigation Aids for Military Aircraft," by S/L. D. Bower.
Feb.	19.	R.Ae.S. Section Lecture: "Glider Design," by K. G. Wilkinson, B.Sc., D.I.C., A.F.R.Ae.S.
Feb.	20.	British Institution of Radio Engineers: "Search Radar for Aircraft," by P. L. Stride.
Feb.	21.	R.Ae.S.: "Power Steering for Aircraft," by K. G. Hancock, B.Sc., A.F.R.Ae.S., and T. Person, M.A., A.F.R.Ae.S.
Feb.	22.	Helicopter Association: "Helicopter Power Plants," by A. Graham Forsyth, B.Sc., F.R.Ae.S.



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In the left-hand photograph Mr. T. O. M. Sopwith is shown receiving his illuminated address from Mr. H. M. Woodhams, C.B.E., F.R.Ae.S., managing director of Sir W. G. Armstrong Whitworth Aircraft Co., Ltd., while on the right are the four senior directors of the Hawker Siddeley Group immediately after receiving their caskets and illuminated addresses. Seen from left to right are Mr. H. Burroughes, Sir Frank Spriggs, Mr. T. O. M. Sopwith and Sir Roy Dobson. The portrait of Sir Frank visible in the background of the right-hand photograph, is not, of course, so indistinct as it appears here; it is reflecting the photo-flash.

SENIORS' SERVICE

Hawker Siddeley Group Executives Celebrate a Long Time in Harness

SIXTY-SEVEN members of the boards of all the Hawker Siddeley Group companies, met at Grosvenor House, London, on January 9th. After lunch a number of presentations were made, foremost among the recipients being the Group's managing director, Sir Frank Spriggs, K.B.E. Sir Frank, who can lay claim to 38 years' service, received a portrait of himself, painted by Cowan Dobson, which was presented to him by Mr. T. O. M. Sopwith, C.B.E., Hon. F.R.Ae.S., chairman of the Group.

Mr. Sopwith himself (41 years' service), together with the three other senior directors, Sir Frank Spriggs, Sir Roy Dobson, C.B.E., F.R.Ae.S. (38 years) and Mr. Hugh Burroughes, F.R.Ae.S. (37 years), were then each presented with silver caskets and illuminated testimonials in recognition of having given more than 25 years' service.

In expressing his thanks for the portrait, Sir Frank Spriggs stressed the fact that everybody in the Group had the same chance of promotion that he himself had had.

Mention was also made of the fact that it had become a standard practice to present a carriage clock to all employees who had completed 25 years' service. Mr. H. T. Chapman, F.R.Ae.S., who acted as master of ceremonies, remarked that, to date, 1,157 such clocks had been presented to employees throughout the organization. (Perhaps the Group will find that a clock production-line would be a profitable undertaking !)

A PILOT'S GUIDE TO ICING

PRIMARILY intended for those concerned with flight operation, a new report* by the Meteorological Office discusses the main physical and met. aspects of ice accretion. After the relevant physical properties of the atmosphere have been reviewed, an analysis of the factors governing the fraction of water caught by various parts of the aircraft is included. The composition of a number of cloud types is then considered, together with the characteristics of icing to be expected.

Up to this point the report may be termed academic, yet it should be of great help to pilots in its clear and concise presentation of background knowledge. The remaining three chapters are eminently practical, dealing respectively with airframe and engine icing and flight procedure.

The section on airframe icing shows that, while accretions are most severe on leading edges, they may also build up out of sight of the pilot, who may only infer their presence by the performance of the aircraft. A photograph of the underside of a DC-3 wing vividly illustrates this point and also shows the build-up of ice on each of the mushroom-head rivets under the main spar.

The next chapter principally concerns piston engines, although a brief section on gas turbines notes the sensitivity of axial compressors to even a light accretion. The final—and probably most valuable—section describes the precautions which (apart from the use of de-icing equipment) should be taken, both before and during flight, to avoid ice accretion. Mention is made of the employment of radar for the detection of liquid and frozen water in the atmosphere, and of the types of echo to be expected from a given kind of atmosphere. Emphasis is laid on the fact that, while icing will probably be minimized by avoidance of radar echoes at air temperatures below O deg C, the absence of an echo does not imply freedom from icing.

In conclusion, descriptions are given of a number of standard types of atmosphere, together with hints upon adopting the best flight procedure. As an appendix, eight charts are provided showing the mean heights of the isothermal surfaces of O and —40 deg C for representative months in the Northern Hemisphere. The accompanying photographs are excellent.

* *"Ice Accretion on Aircraft"* (*Meteorological Report No. 9*). *Price* 1s. 9d., *H. M. Stationery Office.*

GAS-TURBINE SPRAY ANALYSIS

"Rate of Evaporation of a Kerosine Spray," by W. Sacks. Note 7, Reports of Canadian National Aeronautical Establishment, Ottawa.

THE mechanism of the ignition of kerosine sprays by electric sparks, as occurs during the light-up of a gas turbine, is at present imperfectly understood. During Canadian experimental work it became desirable to estimate the rate of evaporation of such sprays, and this is the resulting report. The method adopted was to pass an air stream at a controlled rate through a spray in a cylindrical chamber, and determine the resulting fuel concentration by gravimetric analysis. The measured evaporation was one-hundredth of that calculated by equations derived by Hopkins and Probert from the Rosin-Rammler distribution law. The report attributes this difference mainly to the inaccuracy of the simple Langmuir evaporation expression when applied to a collection of droplets.

Commercial Aviation Commentary

By HENRY MORRIS

THE extent and pattern of the B.E.A. re-organization has recently been revealed.* As was expected, the aim is a "rationalization of the pyramid" by the elimination of the Continental and English groups of services and the transfer of more direct executive authority to head-office departmental chiefs, so that they will no longer have to channel their executive control through the service groupings. Undoubtedly this is a sound move in principle, but whether it will result in any direct economies, or only in delayed indirect economies through greater efficiency, remains to be seen. The new organization reverts very closely to the original conception of B.E.A., and many of the old hands may cynically comment that B.E.A. has now completed its first cycle of re-organization—as compared with B.O.A.C., which is approximately two-thirds of the way through its second or third cycle!

It is interesting to recollect that the original conception of B.E.A.—to a great extent the work of John Brancker—did, in fact, provide for a comparatively small, compact head office of four or five main functional departments, responsible not only for policy and planning but also for the day-to-day direction of their own departmental functions through the whole Corporation. There were to be small administrative sections to cover the needs of the functional departments. There was also, of course, a concession to Scottish Nationalism by the provision of a Scottish division. In effect, the operation of the services was to be handled by the technical, traffic and sales departments, with supplies, staff and administration, finance, and the small research units backing and ancillary to those main functional departments.

That, roughly, was the pattern on which B.E.A. started and there seems no logical reason why, with minor modifications and improvements, it should not have continued that way. But the re-organization bug which seems to afflict all State corporations (or to infiltrate into them with each new management that comes along) soon got to work on B.E.A., and the usual cycle started—"three divisional," two divisional," "one divisional," and then back to "no divisional."

• • •

IN this latest set-up there are more head-office functional departments than in the 1946 conception and a new idea is the establishment of a movements and scheduling director alongside, and at the same level as, the traffic and operations directors. No doubt the idea behind this is that the successful development of B.E.A. is going to depend so much on achieving the very highest utilization by means of the most astute scheduling that it warrants a separate department and director.

It is difficult, however, for the outsider to appreciate how scheduling can be divorced from operations and traffic. So, not knowing the reasonings of the B.E.A. executive, one cannot help suspecting that this new function was devised to overcome an awkward personnel problem arising from the re-shuffling of posts. This tendency to suit re-organization patterns to personalities, instead of making a clean break with an organization in which personalities are fitted to functions, has become an only too common practice. Although it possibly defers the unpleasant duty of declaring a redundancy or a demotion, it usually means that the re-organization fails to achieve its object, so that sooner or later another either minor or major re-organization becomes inevitable.

In this particular case it would have seemed logical for the specialized (and certainly very important) job of achieving the most efficient fleet utilization and scheduling to be placed under the operations director and handled by a specialist—a slide-rule type of comparatively junior status.

Nevertheless, the B.E.A. board and executive are to be congratulated on undertaking this fairly drastic re-organization, the form of which indicates that B.E.A. does appreciate the importance of head-office concentration on the commercial, sales, and traffic-handling aspects of an airline as well as on high policy and on long-term planning. It is also interesting to see that the newly created senior head-office posts, such as those of traffic director, sales manager and commercial manager, are filled by some of the old hands themselves; so there seems to be a re-emergence of appreciation of the value and worth of these pioneering types.

• • •

IT is no secret that charter operators and air brokers have lately been eyeing each other somewhat suspiciously and have been trying to re-assess reciprocal values. The operators have felt that the brokers have taken too much commission on charter work which, in the operators' view, would have gone to the charter companies anyway. In other words, that the brokers have not generated new business but merely succeeded in filtering existing business through their net—and so collected very handsome commissions for doing little productive work.

The brokers, on their part, have contended that the extensive world-wide link-up which they offer gives the charter operators a sales organization which few, if any, operators could support on their own. They also claim that they have generated new business. This being so, they feel they are justified in expecting a fairly handsome commission on the business they introduce and that, moreover, they secure a considerable amount of work for British operators which would otherwise go to foreign companies.

Relations became strained some months ago, when the severe rate-war was at its height between charter operators, many of whom were falling by the wayside. As charter rates fell to successively lower levels the volume of traffic naturally increased. But falling rates meant that already minute profit-margins were converted into increasing deficit margins. So the operators somewhat naturally felt that the brokers should voluntarily reduce their commission rates—or at least agree to a new scale basis for commission. The brokers, on the other hand, felt that as they were bringing in an increasing volume of business their commissions should, if anything, increase.

Thus the inevitable end was hastened; more flying meant more losses, so many operators took the first opportunity to dispose of their aircraft at good prices. The few surviving operators concentrated their efforts on securing steady Government work (which, incidentally, does not earn commission for brokers), the market charter-rates hardened, low-rate loads dropped away and, as the aircraft shortage became intensified, brokers even found difficulty in securing capacity for some higher-rate loads.

• • •

THIS change in the situation has made both the operators and the brokers ponder very hard as to how and why they clashed in the past and how to make certain that in future they work more hand-in-glove and with better appreciation of each other's interests and problems. The brokers are now recognising that they cannot glibly assume that air broking methods should, or can, follow the practices built up by the Baltic shipping brokers. It has been forcibly brought home to them that the endless national and international restrictions which harass non-scheduled air operators leave a very small slice of the cake for the charter operators, and that the dividing line between economic and uneconomic air operations is very narrow and precise. They now understand that there is a very definite limit beyond which rates cannot be depressed; that although 10 per cent on a charter rate of, say, £3,000 is almost as welcome to a broker as 10 per cent on £3,500, the

(Concluded on page 84)

*A diagram of the new administrations structure appeared on p. 763 of "Flight" for December 14th.

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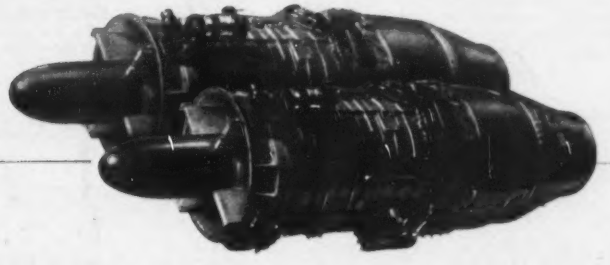

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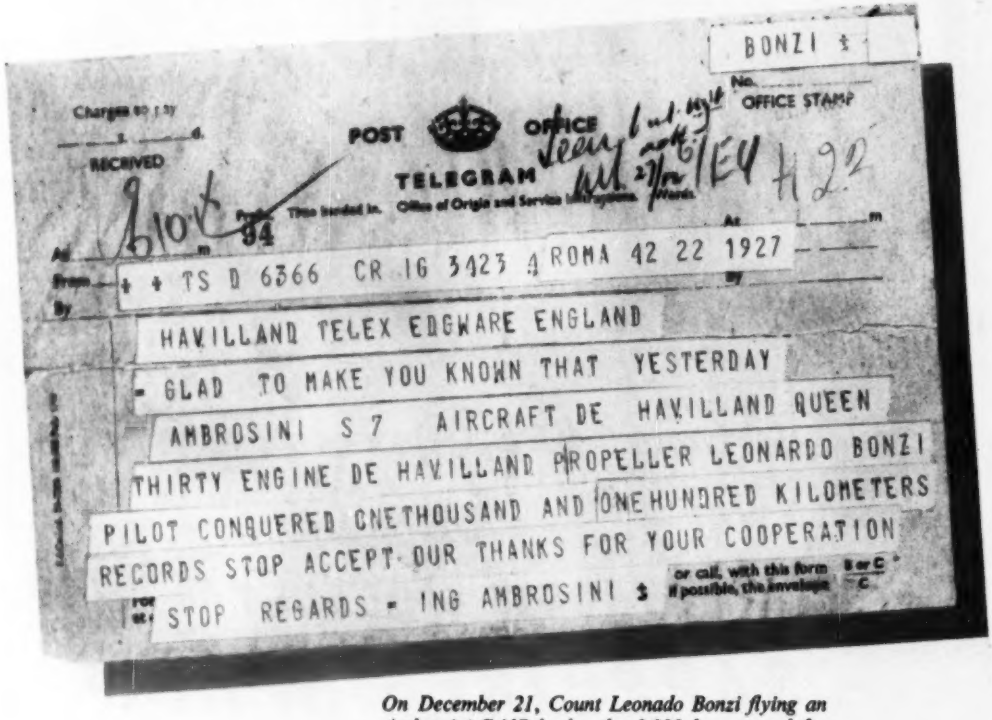
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On December 21, Count Leonado Bonzi flying an Ambrosini SA17 broke the 1,000 km. record for light aircraft (223.067 KPH) by 124.295 KPH achieving an average speed of 347.362 KPH (215.85 MPH).
The 100 km. record (271.084 KPH) was raised to 358.673 KPH (222.84 MPH).

(These claims are subject to official confirmation.)

DE HAVILLAND

DH ENGINES

DH PROPELLERS

One of the earliest "Flight" photographs of the original prototype Canberra B.1 (two Rolls-Royce Avons) which made its first flight on Friday, May 13th, 1949, with W/C. R. P. Beamont at the controls.

BACKGROUND TO A BOMBER

History, Design, Construction and Development of the Canberra

ENGLISH ELECTRIC Canberra! Though already three years old, it is a name which still grips the imagination; one, moreover, which is backed by a history dating from 1912, for in that year the Coventry Ordnance Works—later to become one of the components of the English Electric Group—produced a biplane for the officially sponsored Military Trials. With Dick, Kerr and Co., Ltd., of Preston, the Phoenix Dynamo Manufacturing Co., Ltd., of Bradford, Willans and Robinson, Ltd., of Rugby, and Siemens Dynamo Works, Stafford, the C.O.W. merged to form the English Electric Company.

During the First World War the three first-named firms built landplanes and floatplanes to official designs; Willans and Robinson made aircraft engines, and Dick, Kerr and Co. and the Phoenix Dynamo Company between them were the largest manufacturers of flying-boats in the country. From their works came a variety of types ranging in weight from about 7,000 lb to more than 30,000 lb, notable among which was the Cork, of 85ft span, and powered with two Rolls-Royce Eagles or two Napier Lions. The Ayr, which was flying in the early post-war years, was unorthodox in having its lower wings formed as extensions of the hull; they were given a very sharp dihedral angle and provided lateral stability on the water.

One of the better known and most successful of the early English Electric types was the Wren high-wing monoplane, which had an A.B.C. engine, nominally of 3 h.p., but developing 6-7 h.p. at 2,600 r.p.m.

In 1926 English Electric closed down its aviation department, but during the rearmament period preceding the outbreak of the last war the company approached the Government with an offer of manufacturing facilities for aircraft at Preston, and in 1938 received a contract for Handley Page Hampdens. Later, Halifaxes were ordered, and in 1942 the company acquired control of D. Napier and Son, Ltd., of Acton.

War-time production totalled 80 Hampdens and 2,920 Halifaxes. In post-war years the company has been building Vampires on behalf of the de Havilland Aircraft Co., Ltd., and the majority of all Vampires in service throughout the world are products of English Electric.

Plans for the company's return to aircraft design, as well as production, were laid in 1945, when Mr. W. E. W. Petter, B.A., F.R.Ae.S., formerly technical director of Westland Aircraft, Ltd., was appointed chief engineer. The Canberra idea had begun to take shape in Mr. Petter's brain in 1944, and on joining English Electric he was enabled to gather round him a small team of very capable specialists to assist in bringing it to fruition. Initially a low-level attack machine had been envisaged, but a study of jet-bomber possibilities brought about a change in official views, and a design contract was finally placed with English Electric for a high-altitude aircraft to be powered by two Rolls-Royce Avon turbojets. For defence it was to rely on the excellence of its performance, not only in respect of speed, but altitude and manœuvrability also. And so it was that the Canberra came into being.

Interviewed by *Flight* during 1949, Mr. Petter explained that the technical solution was found to lie primarily in the right choice of wing. A light wing-loading, comparatively low aspect ratio, smooth structure and modest thickness/chord ratio were deemed to be pre-requisites, and sweepback was found to be unnecessary at the Mach numbers attainable when carrying a useful military load with the thrust likely to be available from two Avons during the operational life of the aircraft.

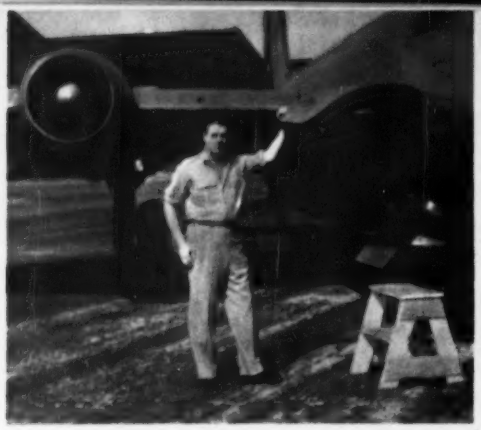
Throughout the development period extensive use was made of research and test equipment with which the English Electric design staff at Warton is well supplied. Especially valuable were the 9ft by 7ft wind tunnel, a high-speed tunnel and a large "cathedral-type" test frame—all located in a single building.

The only detailed description of the Canberra which has been authorized applies to the original B.1, though later marks are essentially similar. The 64ft mid-positioned wing is of symmetrical, high-speed aerofoil section, and of single-spar construction. There is no conventional centre-section and the port and starboard spars are joined by a bridge member spanning the fuselage, the connection being made in fork/lug fashion direct to the boom ends, with double horizontal pins top and bottom. The mainplane and fuselage skins run together in a perfectly clean intersection, without filleting. The wing carries pressure-balanced ailerons with spring tabs, hydraulically operated split trailing-edge flaps, and finger-type air brakes in top and bottom surfaces.

Of circular section, the fuselage is built in three parts—the

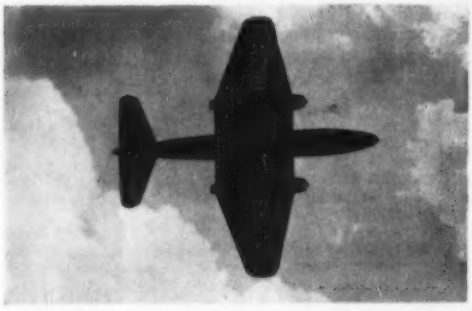
"Flight" photograph

The biplane built by the Coventry Ordnance Works—later one of the components of the English Electric Group—for the Military Trials of 1912.



(Left) A "Flight" portrait of W/C. R. P. Beamont, D.S.O. and Bar, D.F.C. and Bar, chief test pilot of the English Electric Company since 1947. (Above, top to bottom of picture) the first, third, second and fourth Canberra prototypes. The second had Nenes; others were Avon-powered.

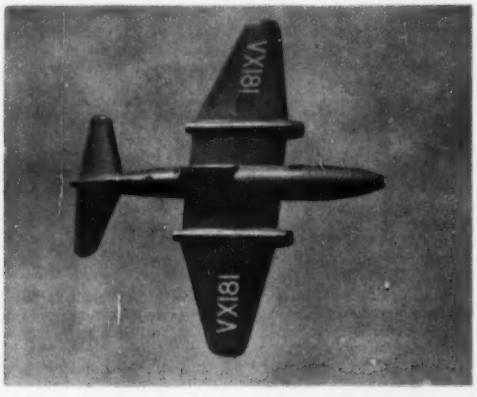
BACKGROUND TO A BOMBER . . .

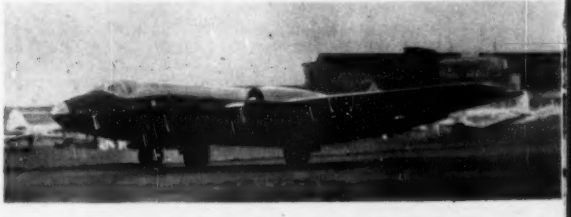


pressure cabin, centre fuselage and the rear fuselage—all attached by transport joints. Transverse frames are closely spaced and the stringers are continuous. The bomb doors are fitted with rollers which slide on curved tracks so that they retract well into the fuselage, the doors themselves being operated by hydraulic jacks through remotely controlled selectors.

A feature of the Canberra's design, embodied primarily to give positive control at high Mach numbers, but valuable also as an aid to manœuvrability, is the variable-incidence tailplane. The actuator—of English Electric manufacture—ensures irreversibility of control under all conditions of flight,

Reading from top to bottom, on the left, are the first B.1, the B.1 powered experimentally with Rolls-Royce Nenes, and the B.2, with bomb doors open. Illustrated below this caption are the first prototype of the P.R.3, with camera ports in evidence, the Armstrong Siddeley Sapphire-powered test-bed, and the prototype of the B.5, with wing-tip tanks.





and enables quick changes to be made in fore-and-aft trim during take-off, flight and landing. The elevator has a spring tab and a geared tab, and the rudder is also provided with a spring tab, which, through an electrical actuator, serves additionally as a trim control, allowing feet-off handling during single-engine flying. All main controls are operated by push-pull rods and levers. Special seals at the pressure bulkhead prevent leakage of air from the cabin, but allow full freedom of movement.

Each main unit of the undercarriage is of English Electric design and incorporates an oleo-pneumatic shock-absorber strut. The nosewheel unit is of the Dowty lever-suspension, liquid-sprung type, with twin wheels.

So compact is the Rolls-Royce Avon turbojet that each is housed entirely forward of the main spar, on four self-aligning mounting points. The removable cowlings consist of a front circular cowl secured on a hoop and attached over the leading edge, two main top and bottom removable panels, and an underneath servicing panel secured by four flush toggle-fasteners. Engine changing is a straightforward task and is accomplished by removing the detachable cowlings and lifting the Avon bodily on a sling.

It is much to be regretted that flying facilities were not accorded during the visit to the first Canberra squadron, described elsewhere in this issue. This being so, the following impressions by a member of *Flight*'s staff who was fortunate enough to have access to one of the B.1 prototypes are of particular interest. He wrote: "The cockpit layout is excellent. Having climbed up through the entry floor in the starboard flank of the nose, and settled oneself in the pilot's seat, the generous amount of space and the workmanlike arrangement of everything becomes genuinely apparent. To the left of the blind-flying panel, immediately forward of the spectacle-headed control column, is a machmeter, whilst the engine instruments are grouped on the right in a panel raked at between 10 and 15 deg, so as to reduce parallax; auxiliary service instruments are carried to the right of the engine instruments. Beneath the blind-flying panel is the tailplane-incidence control and indicator, together with the main engine-switches, whilst the throttles and fuel cocks are positioned at the forward end of an inclined shelf to the left of the seat, together with the several switches for flap operation, rudder trim, bomb-door operation, hood jettison and control-column release. Actuator buttons for the Graviner fire-suppression system are fitted above the engine-instrument panel.

"Behind the pilot, but on the centre-line of the aircraft, is the navigator's station—also furnished with a Martin-Baker ejector seat. To complement the latter the fuselage roof above the seat is arranged as a jettison escape-hatch, and, to provide the navigator with direct light, the hatch incorporates a circular panel of Perspex."

Only four examples of the Canberra B.1 were built. They were two-seaters and had no bomb-aimer's panel. The second was powered with Rolls-Royce Nenes, for which production was never planned, but which was at one time considered as an insurance policy against delays in Avon development.

Friday the 13th of May, 1949, was the date of the maiden flight by the first prototype Canberra B.1, registered VN799. At the controls was W/C. R. P. Beamont, D.S.O. and Bar, D.F.C. and Bar, chief test pilot of the English Electric Company since 1947. From the start it was seen to be an aircraft of exceptional flying qualities, and when VN799 made its debut at the S.B.A.C. Display in September, 1949, the only major modification noticed was a reduction in the height of the vertical tail surfaces. *Flight*'s report of the occasion ran: "W/C. Beamont's introductory performance in our first jet bomber was historic. The initial climb, with the Avons roaring and rumbling far into the distance, would not have shamed a Meteor; then the beautiful medium bomber bore down fast along the runway and rolled away (one roll in each direction), its blue shape seeming, chameleon-like, to change its hue against the varicoloured clouds. A second run culminated in a perfect roll-off. . . . A new aircraft has never been more convincingly demonstrated."

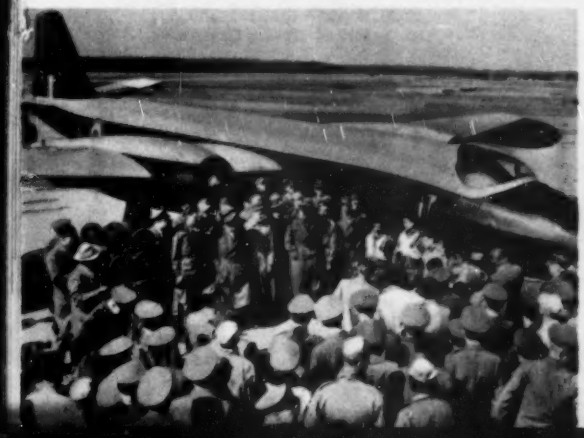
"Flight" photograph

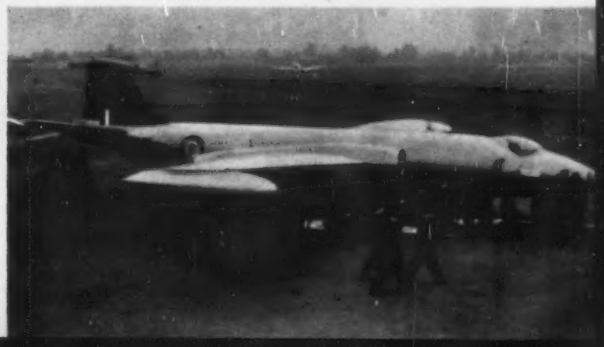
Refuelling the standard production-type Canberra B.2, which, on February 21st, 1951, made the first direct Atlantic crossing by a jet aircraft.

The official naming ceremony (originally the aircraft had been known as the English Electric "A.1") took place at Biggin Hill on January 19th, 1951, and was performed by the Rt. Hon. Robert Menzies, Prime Minister of Australia. It is not perhaps generally known, incidentally, that the Canberra owes its name to Sir George Nelson, chairman and managing director of the English Electric Company. In accordance with tradition, the Air Ministry had asked Sir George, as head of the designing and manufacturing firm, to suggest a name. "Being a fervent believer that the peace and happiness of the world depend on the unity and understanding of the British Commonwealth," Sir George says, "I sat down to think of a suitable name for this machine to further that object, and chose Canberra, the capital of its farthest-flung country, the Commonwealth of Australia. This was immediately accepted by the Air Council."

The next historic event in the Canberra's career was its direct Atlantic crossing—the first by a jet aircraft—on February 21st, 1951. The aircraft was of the B.2 mark, with Avon 1 engines, having cartridge-operated turbo-starters. (The B.1s had been fitted with electric starters.) Other differences were the provision for crew of three, a transparent nose section, cabin pressurizing from the Avon compressors instead of from two-stage blowers, and wing-tip tanks.

The crew for the Atlantic flight were S/L. A. E. Callard, D.F.C. (pilot), F/L. E. A. J. Haskett (navigator), and F/L. A. J. R. Robson, D.F.C. (signaller), all of the Aeroplane





Left, the crew of the first Canberra in the United States face the cameras and microphones at Andrews Air Force Base, Maryland, after flying down from Gander, Newfoundland. Below, the first Canberra for the R.A.A.F. is seen at Lyneham prior to its delivery flight. The pilot was W/C. D. R. Cuming, chief test pilot of the R.A.A.F.

A "Flight" impression secured during the initial presentation of the Canberra B.1 prototype, which aroused very great public interest at the S.B.A.C. Flying Display of 1949.

W/C. Beamont demonstrating a Canberra B.2 at Baltimore. Spectators included employees and friends of the Glenn L. Martin Company, which is to build a night-intruder version for the U.S.A.F.

BACKGROUND TO A BOMBER . . .

and Armament Experimental Establishment at Boscombe Down. The Canberra took off from Aldergrove, Northern Ireland, and crossed to Gander, Newfoundland (a distance of 2,100 miles) in 4 hr 37 min, giving an average ground speed of 450 m.p.h. Headwinds of up to 80 m.p.h. were encountered and the greatest height attained was 48,000ft.

In 1951 it was announced that the Canberra B.2 would be produced not only by English Electric, but by A. V. Roe and Co., Ltd., Handley Page, Ltd., and Short Brothers and Harland, Ltd. The B.2 was also named as the version to be built in the Australian Government factory at Fishermen's Bend.

Another important item of news during May, 1951, was that large numbers of a night-intruder version of the Canberra were to be built for the United States Air Force by the Glenn L. Martin Company, of Baltimore. Bearing the designation B-57A, the American-built Canberra will be powered with Armstrong Siddeley Sapphires, built under licence by Curtiss-Wright, and will be armed with fixed, forward-firing guns. Other changes will involve a redesign of the bomb bay, to accommodate a larger number of smaller bombs, and alterations to the fuel tanks to take the American JP-3 fuel.

The first Canberra to be delivered to the Royal Australian Air Force left Britain on August 1st, 1951, and reached Darwin, Northern Australia, in a total flying time of 22hr 5min. The distance was 10,249 miles. The pilot, W/C. D. R. Cuming, chief test pilot of the R.A.A.F., remarked in Australia that the Canberra was "easier to fly than the old Avro Anson trainer." *En route* to Laverton, the Canberra was escorted by two Vampires, which were hard pressed to keep pace with it, and as W/C. Cuming was leaving the tarmac one of the pilots stepped forward and said to him, "Sorry you had to throttle back, sir, but we were flat out."

A demonstration by W/C. Beamont at Royal Air Force station, Biggin Hill, on the occasion of the official naming ceremony of the Canberra, performed by Mr. Menzies, the Australian Prime Minister.

S/L. Callard's unofficial record for the transatlantic crossing was beaten by a substantial margin on August 31st, 1951, when, under the official surveillance of the Royal Aero Club, acting for the F.A.I., a second Canberra B.2 was delivered to America by W/C. Beamont. His time was 4 hr 18 min 29.4 sec. Navigator on this record-breaking flight was Mr. D. A. Watson; Mr. R. H. T. Rylands was the wireless operator.

Latest variants of the Canberra to be announced are the P.R.3, which carries special equipment for high-altitude photographic reconnaissance, and the B.5, which differs superficially from the B.2 in having a larger bomb-aimer's panel. One B.2, fitted experimentally with Sapphires, put up an impressive performance at Farnborough last year.

A number of firms in the aircraft and associated industries contribute materials, components and accessories to the construction of the Canberra, and among them are the following:—

Martin-Baker Aircraft Co., Ltd.; Dowty Equipment, Ltd.; Automotive Products Co., Ltd.; Vokes, Ltd.; Fireproof Tanks, Ltd.; Rotol Ltd.; Hymatic Engineering Co., Ltd.; Dunlop Rubber Co., Ltd.; Wm. Jessop and Sons, Ltd.; Marconi's Wireless Telegraph Co., Ltd.; Northern Aluminium Co., Ltd.; James Booth and Co., Ltd.; Sperry Gyroscope Co., Ltd.; Thomas Firth and John Brown, Ltd.; Brown Brothers (Aircraft), Ltd.; T. J. Brooks (Autos), Ltd.; Guest, Keen and Nettlefolds, Ltd.; Rubery, Owen and Co., Ltd.; H. Terry and Sons, Ltd.; J. Stone and Co., Ltd.; George Tucker Eyelet Co.; Aviation Developments, Ltd.

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FLUTTER

Clearance Tests in Flight: Part II of the R.Ae.S. Lecture by Broadbent and Kirkby

IN introducing the second part of the lecture (the first part, given by Mr. Broadbent, was dealt with in last week's issue of *Flight*), Mr. W. T. Kirkby said that the development of the theoretical approach to flutter problems had been seriously hampered by the fact that little experimental full-scale evidence had been obtained to substantiate the theoretical work. Much of the evidence that had been obtained had been of a negative nature, i.e. no flutter had been predicted and no flutter incident had occurred. In the cases where flutter had occurred, it was often in degrees of freedom not considered in the pre-flight calculations, and had not always lent itself to theoretical explanation.

There were two main aspects of full-scale flutter experiments. First, experiments forming part of a general research programme intended to check the validity of the appropriate theoretical calculations, and also intended to fill some of the gaps in existing knowledge by supplying information on modes in flight, and Mach-number effects. Second, flight experiments to form part of the development flying programme on prototype aircraft, or aircraft to which changes had been made which might affect the flutter conditions (i.e., tip tanks, external stores, modifications to control circuits).

In the space available it was not possible to cover both the foregoing aspects and this part of the paper was concerned primarily with the flutter clearance tests made during the normal test and development flying period of a particular type of aircraft.

In the past, many flutter incidents had occurred in the course of test flying, often when some other flight characteristic of the aircraft was being investigated. Such incidents had usually occurred when the aircraft had exceeded the speed attained in previous flights, although a few incidents had occurred when flying in bumpy weather, at a speed less than the previous maximum, or at higher altitudes. These incidents had rarely been catastrophic, although in some cases there had been structural damage, but in any case they had an adverse effect on the morale of the crew of the aircraft. Fortunately, the linearity of coefficients that had to be assumed to make the theoretical calculations manageable was not realised in practice, otherwise most of the incidents would have been divergent and consequently disastrous.

It was clearly desirable to adopt a flight technique which would indicate the approach to a flutter condition and thus lessen the risks to the crew and the aircraft. It was appreciated that the aircraft manufacturers already had formidable flight-test programmes, and that any further additions were unwelcome, but it was suggested that flutter check-tests could substantially reduce the risk of an unforeseen incident occurring, often without much additional flying, and with simple instrumentation. Often it might be possible to carry out the flutter clearance tests in the course of flights forming part of the general test and development programme.

It was only in comparatively recent years that serious consideration had been given to flight flutter testing of a routine, rather than of a research, nature and consequently there was a lack of the background of experience and period of development that was available in many other fields of flight testing. The methods that were now considered represented present views, which might well be modified as further experience was obtained and as development proceeded.

The principle underlying all test methods was to excite the flutter modes of the aircraft from a controllable energy source, beginning at an air speed well below the maximum air speed, or calculated critical flutter speed, and to measure the response of the aircraft to the known energy input at increasing air speeds. The air speed was increased in small steps until the maximum permissible speed of the aircraft was achieved, or until the response to the input energy showed that a flutter condition was being approached. In the general case it was desirable to excite all modes of the aircraft to ensure that the flutter modes were not missed; in the particular case, attention might be focused on a mode which might be suspect from the flutter point of view.

The lecturer said that two methods of exciting the aircraft modes were considered in the paper :—

(i) *Forced vibration.*—A sinusoidal force of variable frequency was applied to the aircraft structure or controls, as in ground resonance testing.

(ii) *Transient response.*—A manual "jerk" was applied to the controls of the aircraft which would excite transient response in several modes at the same time. The degree of forcing of each mode, resulting from the jerk, would depend on the shape of the force/time curve, and it was theoretically possible to excite all the relevant structural modes by this method.

The response of the aircraft structure to the energy input at each increment of air speed was determined from the damping in the modes. The value of the damping might be obtained from the resonance curves or from the decay oscillations, depending on which method of excitation was used. This damping value, which included the aerodynamic and structural terms, might be plotted against the equivalent air speed and the approach to a flutter condition would be indicated by an adverse change of slope of the curve or approach of the damping to zero.

The general method just outlined was not original. It had been developed from methods suggested by von Schlippe, who proposed measurement of amplitude response to continuous forcing, and Grossman, who advocated measurement of damping in decay oscillations. A preliminary investigation, in which the damping measured from decay oscillations excited by manual jerking methods was compared with theoretical damping values, was reported by Rosenbaum and Scanlan in 1948. The latter method had subsequently been used with success both in this country and the United States. In certain cases the manual "jerk" method was not satisfactory, and the general problem of excitation of the aircraft modes was now examined briefly.

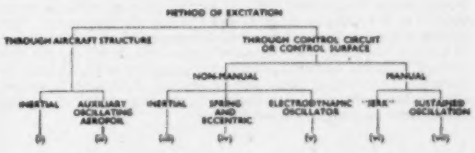

Fig. 7. "Tree" summary of various methods of excitation.

Mr. Kirkby went on to say that experience had shown that control-surface flutter did not occur at frequencies higher than five to six times that of the lowest structural frequency, and it was not considered necessary to excite frequencies higher than this during the flutter clearance tests. The various methods of excitation which had been considered were summarized in *Fig.* 7.

(i) and (iii) *Inertial excitation of aircraft structure or control surfaces.*—This method was used generally in ground resonance testing and had been adequately described elsewhere. Care had to be taken to ensure that the mass of the exciter and associated driving equipment did not alter appreciably the modes of the aircraft. If possible, the exciter should replace a piece of aircraft equipment of equivalent mass. The disadvantage of inertial exciters became apparent at very low frequencies, when an extremely large amount of out-of-balance was required to produce the desired force, and the weight of the exciter became prohibitive. For this reason inertial exciters would seldom be used to excite frequencies below approximately 3 cyc/sec. When such exciters were fitted in control surfaces, care had to be taken to ensure that the control-surface mass-balance and inertia conditions were not seriously affected.

(ii) *Excitation of aircraft structure by oscillating auxiliary aerofoil.*—In this method an auxiliary aerofoil of symmetrical section was attached externally to the aircraft structure and a sinusoidal change of incidence, of variable frequency, was forced through a linkage. So far as was known, this method had not been tried in flight, but a preliminary design study had been made at the R.A.E., from which it appeared that the scheme might be practicable for frequencies from 5 cyc/sec down to zero. The disadvantages of this method were that the force produced varied approximately with the square of the air speed, and also that it was difficult to position the aerofoil so that the airflow round the lifting and control surfaces of the aircraft was unaffected by the proximity of the aerofoil. Because of the complexity of the installation it was probable that this method was better suited to long-term research investigations than to tests of a routine nature.

(iv) *Excitation of control circuit by spring and eccentric.*—Although attractively simple, this method of excitation suffered from the inherent disadvantage that the spring, in effect, linked the control circuit to the airframe and, consequently, the dynamic characteristics of the control circuit would be altered. Flutter calculations would be necessary before using this method of excita-

FLUTTER . . .

tion on a particular type of aircraft in order to assess the probable effect of the change of dynamic characteristics on the results of the flight tests.

(v) *Excitation of control circuit by electrodynamic exciter.*—In this method an electrodynamic exciter of the moving-coil type, supplied by a variable frequency alternating current, was attached to the control circuit and aircraft structure. The particular advantages of this system were that force, amplitude and frequency were easily controlled in flight, and an almost instantaneous cut-off of exciting force was possible. It should be remembered, however, that electrical impedance of the exciter would affect the dynamical impedance of the control circuit to some extent, although it was thought that this effect would not seriously prejudice the method of excitation.

(vi) *Manual excitation by jerking the aircraft controls.*—As discussed before, this method had been used with success both here and in the United States, and it was suggested that, despite some disadvantages, it was a satisfactory method of excitation for aircraft other than those fitted with powered flying controls. Experience had shown that the majority of relevant modes of a particular aircraft could be excited by jerking the aileron, elevator or rudder controls as appropriate. Fig. 8 showed records obtained by this method on a jet fighter aircraft. Undoubtedly in using the "jerk" there was some risk of failing to excite the critical flutter mode, but it was felt that the extreme simplicity of the method justified its adoption as a standard method of excitation.

(vii) *Manual excitation by oscillating the aircraft controls.*—This method had been tried, but in the authors' view it was not very satisfactory. The frequency of excitation was limited by the human element to a maximum of approximately 5 cyc/sec. Furthermore, it appeared difficult for the pilot to vary the force applied to the controls without also altering the frequency. The tendency appeared to be to lower the frequency when endeavouring to increase the force, and therefore it was difficult for the pilot to control, with any certainty, either the frequency or the amplitude excited. The method could not be entirely dismissed, however, since it had been used with success in the United States during flutter tests on a large bomber aircraft.

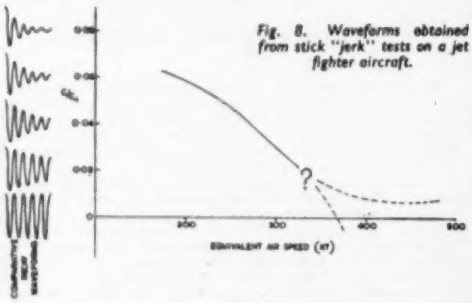

Fig. 8. Waveforms obtained from stick "jerk" tests on a jet fighter aircraft.

None of the methods of excitation through the control circuit mentioned under the above headings was considered satisfactory for aircraft fitted with powered flying controls, because the dynamic characteristics of these controls were such that neither continuously forced oscillations having sufficiently high frequencies, nor sufficiently "sharp" jerks, could be transmitted from the input end to the output end of the circuits. The only systematic methods appeared to be excitation of the airframe to produce inertia and aerodynamic forces on the controls surfaces, or the use of inertia exciters on the controls surfaces themselves. If such methods were considered to be too complicated, the only alternative suggested by the authors was deliberately to fly the aircraft through "bumps" with increments of air speed and to take recordings of the resultant oscillations as in the general method. Such a technique, although better than no flutter tests at all, was obviously far from satisfactory and the development of some simple and reliable method of excitation of powered flying controls was considered to be a major outstanding problem.

Consideration of excitation methods should not be concluded without reference to a recent American proposal in which it was suggested that transient response of the aircraft structure could be excited by small rocket charges set in the surface of the structure. By altering the geometrical shape and burning characteristics of the charge, particular force/time functions could be applied. So far as was known, this method was at present being developed and no flight trials had yet been made.

Mr. Kirkby suggested that simple vibration recording instruments, such as the R.A.E. Mk II vibrographs, should be fitted when the control jerking method of excitation was being used. It was advisable to use three such instruments to record the vibration vertically in the outer wing, and vertically and laterally in the tail unit, to minimise the possibility of overlooking a mode in which the damping was low.

If, during the subsequent flight tests, a condition of low damping was encountered which necessitated investigation before proceeding to higher air speeds, it was strongly recommended that multi-channel recording equipment be fitted at this juncture to establish the structural mode and control surface motion directly in flight. The alternative process of embarking on flutter calculations using the frequency recorded in flight and the appropriate ground resonance tests modes had led to much exhausting and fruitless effort in such situations in the past. Multi-channel electronic equipment made in miniature was at present being developed for use in small aircraft in the foregoing circumstances.

The lecturer observed that, if the continuous excitation technique was being used it was worth while to fit multi-channel recording equipment from the start. The additional amount of work involved was probably small compared with the work involved in the fitting of the continuous excitation equipment, and it was possible to obtain more accurate measurements of damping in the different modes encountered in the frequency range. Considerable effort was at present being put into the development of equipment which would permit direct measurement of the amplitude of the vibration having the forcing frequency only, so that the superimposed vibrations originating from the power plant(s) and aerodynamic "hash" were not recorded. In the meantime much could be done to eliminate unwanted frequencies by the use of electronic filters.

The results were analysed with a view to presenting curves of damping against air speed for the modes excited. The particular method of expressing the damping was not important, but it had been found convenient to use the damping ratio C/C_0 (=actual damping/critical damping), as found from the resonance or decay curves. It was unnecessary to plot damping curves for values of C/C_0 greater than 0.05, which experience had shown to be the value in a reasonably damped mode.

The main difficulty that arose in trying to obtain reliable damping values from the flight test records was caused by the unwanted vibrations, some fairly continuous and some of a transient nature, which were forced by power-plant vibrations, aerodynamic "hash" and "bumps." As mentioned elsewhere in the paper, much could be done to alleviate these problems by forcing relatively large amplitudes and by electronic filters. If continuous excitation was being used, the problem was simplified somewhat, because the knowledge that the amplitude associated with the forcing frequency was constant for that particular recording enabled one to apply the usual graphical analytical methods. When the decay oscillation records were obtained the problem was more serious, particularly when the damping was comparatively high. If the damping was comparatively low, it was possible to average successive logarithmic decrement values from peak to peak in the decaying oscillation. It was probable, therefore, that greater accuracy was obtained when the damping was low than when the damping was high.

As explained in the first part of the lecture, control-surface flutter was affected by equivalent air speed and Mach number, among other variables. For these two particular variables, it would therefore be ideally desirable to cover all combinations of E.A.S. and Mach number that could occur. The amount of flight testing required to approximate to this ideal condition was obviously prohibitive, and experience suggested that the best compromise was to cover the range of equivalent air speeds at the greatest height at which the maximum E.A.S. could be attained.

Mr. Kirkby suggested that the range of air speeds should be divided into suitable increments, with smaller percentage increments as the high end of the range was approached. For example, the increments for an aircraft having a maximum E.A.S. of 500 kt might be arranged as follows: 150, 200, 250, 300, 350, 375, 400, 410, and then by 10 kt increments to 500 kt. The decision as to what increments should be used would obviously be influenced by the results of the pre-flight flutter calculations and by the results emerging from the flight measurements as the tests proceeded.

The decision as to how many air-speed increments to cover in any one particular flight had also to be based on similar grounds, but to some extent the decision could be taken by the crew of the aircraft. If the aircraft was instrumented with electronic equipment and carried an observer, it was possible to get an indication of the approach to flutter either from a monitoring system, or from some type of pen recorder on which the decay curves could be watched. The approach to a low damping condition could often be detected visibly by the response of the pilot's controls or the aircraft structure, after applying the "jerk." The crew should therefore be instructed not to go beyond certain speeds in each flight, and to stop the tests if the damping appeared to be falling

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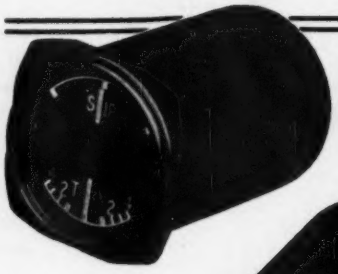

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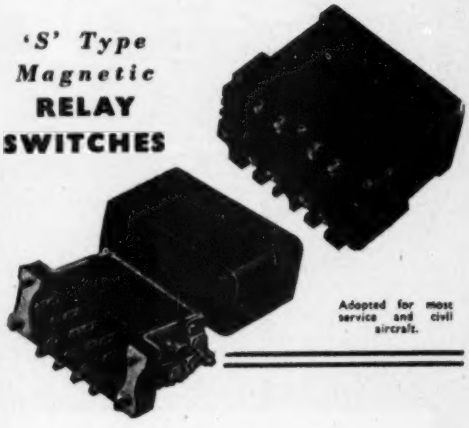

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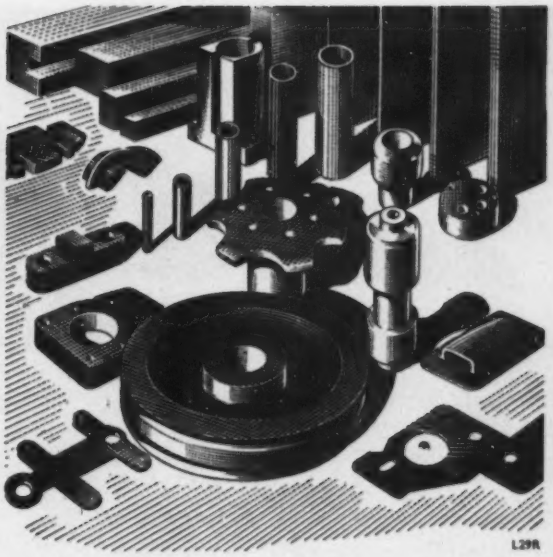

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before reaching the limit set for that flight. To return to the former example, the limiting speeds for each flight might be successively 300, 400, 430, 460, 480, 500 kt, and the increments might be overlapped to repeat the last two records in the preceding flight.

Where continuous excitation was being used, the frequency range should be covered as in ground resonance tests at each increment of air speed. It had been found adequate to record at 1 cyc/sec increments but, in addition, if visual monitoring was possible the frequency should be adjusted so that records could be taken on the resonance peaks. If a rapid cut-off of the excitation was possible, a decay curve could be recorded from each resonance peak, so that the damping obtained from the resonance curve could then be checked by the damping obtained from the decay curve. An alternative procedure was to accelerate slowly through the frequency range and to take a continuous recording. From limited experience it appeared that the slight saving of time in flight was more than offset by the corrections necessary to the results before the amplitude-frequency curve could be drawn, and the damping values obtained.

When the control-jerking method was being used, it was suggested that two or three jerks of each control should be made at each increment of air speed if the length of recording film permitted. There was then a better chance of exciting the potential flutter modes and obtaining satisfactory records.

It was essential that the friction in the control circuits should be reduced to a minimum to prevent variations in the response of the aircraft from flight to flight, which would give rise to erratic results or even to a dangerous situation. In this connection the effect of temperature on control-circuit friction should be considered when, for example, the flutter clearance tests were combined with a flight to high altitude. The backlash in the controls should be representative of the amount that might be anticipated in subsequent production aircraft.

Means of stopping the applied excitation rapidly in the event of trouble in flight were essential. When inertia exciters driven by electric motors were being used, a rapid stop could be achieved by friction brakes or regenerative braking of the motor, or both. Care should be taken to ensure that impulsive loads, which might arise during rapid braking, were not excessive.

The exciting equipment should produce forces sufficiently large to overcome any friction in the control-surface hinges, and to produce amplitudes distinguishable from the normal level of vibration in flight, but at the same time the possibility of damage to the aircraft structure due to fatigue or repeated loadings obviously imposed a maximum permissible amplitude. It was considered that amplitudes at resonance should not in general give rise to alternating stresses in the aircraft structure higher than those arising from the application of ± 10 per cent of proof load, and, if particularly high mean structural loads occurred in any of the flight conditions, it would be advisable to reduce this limit. Some approximate estimate of the maximum amplitudes permitted by this stress limitation could be obtained from theoretical calculations based on the modes obtained in ground resonance tests, but the work involved would generally be prohibitive.

The approach used in recent tests was to assume that the fundamental bending mode of the part of the structure of primary concern (e.g. wings, tailplane) approximated to the deflection form adopted during normal static strength tests, and to use the tip deflection at 10 per cent proof loading as a guide to the limiting amplitude in the fundamental bending mode. The excitation applied at higher frequencies was reduced in the degree that experience had shown to be advisable in ground resonance tests. It was fully appreciated that the approach left much to be desired, and such amplitude would not, in fact, be excited unless it were necessary in order to obtain intelligible records. Rigorous inter-flight inspections were made to detect any signs of structural damage.

No clear-cut guidance could be given as to what force the pilot should apply when jerking the controls. As with continuous forcing, it should produce the minimum structural amplitude consistent with adequate results, and the same general precautions applied. One or two preliminary trials by the pilot, starting with small forces at the low end of the air-speed range, were usually adequate to establish the order of force required. The problem did not appear to be very real in practice, and the authors knew of no case where structural damage had occurred during such tests.

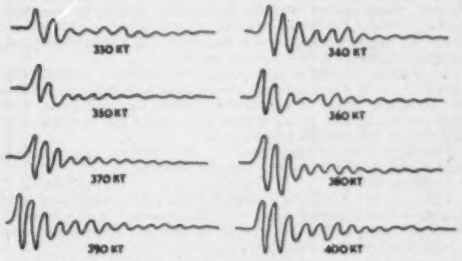

Fig. 9. Hypothetical damping/air speed curve, showing approach to critical condition.

If the damping in a particular mode was seen to be falling seriously during the flight tests, the question arose as to whether it indicated an approach to a critical condition, or whether, in fact, the damping would subsequently rise at higher air speeds. This point was illustrated in Fig. 9. Usually, the slope of the damping/air speed curve might give a general indication of the probability of a critical condition arising, but too much reliance could not be placed on the slope, since it was known that it might change rapidly. The pre-flight calculations which gave solutions for the critical condition only were of little help in deciding whether to proceed to higher air speeds, because there was no means of checking their validity from the experimental evidence obtained up to this stage in the tests. The particular value of making pre-flight calculations, which were not solved for the critical condition, but for rates of decay in the sub-critical region, became apparent in such a situation. The damping/air speed curves obtained experimentally could be compared with the theoretical curves, and if reasonable agreement was evident, reliance could be placed on the behaviour of the theoretical curves at higher increments of air speed.

Although the primary aim of the flutter clearance tests was to establish safely whether the aircraft was free from flutter or not, it was obviously desirable from the long-term point of view that experimental results should provide evidence of the validity of the flutter theory.

From the foregoing, it would be evident that calculations solved for critical conditions, although invaluable in the design and development stage of an aircraft, were of little help either in the conduct of the flight tests or in subsequent correlation of theoretical and test results. Unfortunately, the amount of work required to calculate the damping in the appropriate modes over the air-speed range would be prohibitive from the viewpoint of the aircraft designers. However regrettable, such calculations could be justified at present only in relation to long-term research programmes, although the advent of flutter simulators might make damping prediction a reasonable proposition for prototype aircraft in the near future.

FORTHCOMING R.Ae.S. LECTURES

THE next "main" meeting in the Royal Aeronautical Society's lecture season takes place on Thursday, February 7th, at the Institution of Civil Engineers, when there will be a discussion on *The Availability and Use of Aeronautical Information*. This exchange of views will be made jointly with the Aeronautical Information Group of ASLIB (Association of Special Libraries and Information Bureaux).

Periodically the Society's main lectures are delivered at provincial centres, and the succeeding fixture, on February 21st, will be of this kind; at Hull (Electricity Showrooms), Messrs. K. G. Hancock, B.Sc., A.F.R.Ae.S., and P. Person, M.A., A.F.R.Ae.S., will talk on *Power Steering for Aircraft*.

The next R.Ae.S. Graduates and Students Lecture (held in the Society's library at 4 Hamilton Place, London W.1) will be on January 22nd, when Mr. P. H. Southwell, Grad. R.Ae.S., will speak on *Aircraft in Agriculture*. On January 31st, also in the library, there will be a Section lecture, devoted to *The Problem of Short-haul Air Transport*; the lecturer will be Mr. P. W. Brooks, B.Sc., A.C.G.I., A.F.R.Ae.S.

As a general rule, and unless any special previous announcement is made, non-members are permitted to attend R.Ae.S. lectures on tickets obtainable through members.

MONITORS—NEW STYLE

TWO big U.S. Navy cruisers, the 13,600-ton *Canberra* and *Boston*, are to be converted into guided-missile ships; they will be the first such vessels to be commissioned. "Mothballed" at Bremerton, Washington, since 1946, they were to be moved last week to Atlantic ports, where their main batteries and fire-control equipment will be replaced by launching devices and radar. The U.S. Navy Department expects this work to take two years and announce that, if it proves successful, other warships may be similarly converted.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

A Turbojet by any Other Name . . .

I WOULD like to make the plea that the present confusion over nomenclature for the gas-turbine engine be resolved. Amongst others, the following methods of description are variously used: jet engines, straight jets, turbojets and airscrew turbines, propeller turbines, propjets, turboprops.

Jet engines, straight jets and propjets are frightful. Considering that practically every modern piston engine installation utilizes the jet thrust effect of its exhaust system for propulsion, they could certainly also be described as propjets and perhaps even included in the term jet engines.

Propeller is better than airscrew. The terminology, therefore, surely and simply becomes—turbojet and turboprop.

London, S.W.3. C. D. SOLTZ.

[The late Mr. G. Geoffrey Smith, former Editorial Director of *Flight*, decided several years ago that turbojet and turboprop were the right terms and, except in special circumstances, we always employ them.—ED.]

New Forest Airfield

VERY rarely does *Flight* need correction in historical matters, but in the article "Forty-eight Years Back," on page 23 of the issue of January 4th, there is a small mistake.

"G.D." states that the New Forest School of Flying at Beaulieu was where the present R.A.F. airfield is today. This is not correct, for if my recollection serves me right, the old Beaulieu airfield in 1917 was south of the Beaulieu-Lymington road, and was much smaller than the present R.A.F. station, which is to the north and west of the Beaulieu-Lymington road.

London, E.C.3. A. G. LAMPLUGH.

Production and Manpower

WHILE much of W/C. Charles Gardner's article ("Challenge," January 4th) is excellent, and certainly the theme is compelling, I feel that the writer has not made the best use of his quoted figures.

He shows that a car is worth roughly £500 per ton and the Comet £23,000, but apparently moves the "5" in the £500 one place to the left before subtracting it from the Comet's value per ton, since he arrives at an increase of £18,000 per ton, which surely should be £22,500.

This figure is even more impressive, but all our aircraft will not bring in such ton values, for not all our trade consists of Comets; many of our exported aircraft are smaller, simpler types netting a smaller value per ton.

Thus, if we take an average value per ton for our car exports we must use a similar average for our aircraft; this, though giving a smaller increase per ton for aircraft than the writer gave on his reasoning, would still make it worth while to turn all our car workers to aircraft production. But surely, though figures per ton may be very impressive in themselves, they prove little, for it is the total revenue which has to be considered.

From W/C. Gardner's own figures, car exports net £178 million, while it is very probable, though not certain, that aircraft would be worth £100 million. Turn all your car workers to aircraft and you lose £178 million to gain £100 million, which is a net loss of £78 million—not very economic. Still using his figures, if we could neglect the rearmament drive, taking just less than one-third of the workers from car production and putting them to work on airliners, we still have two-thirds of our car industry which would mathematically still net £119 million per annum, to which we add our £100 million aircraft export trade and get £219 million, an increase of £41 million. To use the word beloved of our present-day economists, the "productivity" of our 100,000 workers has increased, since each is "worth" £1,000 to the aircraft industry exports against £593 for car exports.

Admittedly our car exports cannot stay at the figure quoted for long; already unsaleable cars are being returned from the New World. I do not agree that this is any reason to sacrifice our car exports; rather I think we should make as much money from them as we can, while we can. But, of course, we must build up our aircraft exports and as a long-term measure it would be good policy to sacrifice our dwindling car trade to this end—*if it were necessary*.

I have said before that total exports must be the criterion, but while 100,000 workers transferred from cars to aircraft would raise our total exports by £41 million, if we could find these workers from some source not engaged in exports our export increase would be £100 million. That source I believe to exist, although I do not have the accurate figures; if my memory serves there should be ample numbers available for both rearmament and airliner construction in the ranks of our Civil Service. Some Civil Servants are essential, few are profitable; our present numbers are crippling, in cost, red-tape and, greatest, in waste of manpower.

I personally know young, single men who would rather work at, say, £6 per week as a Civil Servant than at £10 per week in an aircraft factory. Why? They point out that it is easy to work in an office, sitting down all day and just pen-pushing. To work in a factory, they say, they would probably have to stand all day, the work would be harder and more tiring, half the extra wages would go in income tax and the rest in lodging fees, as many are now living cheaply at home. It just is not worth the trouble!

Reorganization and streamlining of the Civil Service, cutting it to the absolute minimum, would go a long way towards solving this manpower problem.

Cambridge. PEDANTICA.

SHORTAGE of labour in the aircraft industry, is, to my mind the fault of the leaders of the industry, and the solution is in their hands. I don't ever remember Lord Nuffield sitting down and crying for the Government to give him men. What the industry must do is to make jobs attractive by giving good wages, and to take in men and women of 20 to 35 and *train* them. It's no good continually advertising for trained men—they don't drop off trees. At present you can get trained men in the aircraft industry only by taking them away from someone else in the same industry who wants them just as much as you do.

There are, however, hundreds of men in every town—in the retail distributive trades, bus conductors, gardeners, etc.—who have never had a chance to get into a well-paid job but who would probably jump at an opportunity.

Another point is dispersal. Manufacturers should have satellite factories as during the war, then housing wouldn't come into it. At present much of the industry is in about 20 towns, which also have other well-paid trades flourishing locally, whilst there are dozens of other towns where most men can't earn more than £6 per week.

In a nutshell: If you can't get enough men to the job, take the job to the men; and if you can't get enough trained men (and you obviously won't) recruit your labour from the great number of untrained men; offer them good terms and permanent jobs, and *train* them to do the job.

The manufacturers might also advertise for staff in the same attractive way as they advertise the aircraft they haven't got to sell.

Hants. A. JOHNSON.

THE difficulty now being experienced in securing a steady increase in people with "know-how" in the aircraft industry is undoubtedly due to some extent to the lack of any prospect of continuity of employment.

My own case must be typical of many others. After many years' experience in the industry, including a number of years in responsible technical, flying and administrative posts, I was, shortly after the end of the last unpleasantness, "released" with little more than a letter of thanks, and forced to start at the bottom again in other employment.

I would gladly go back to a job I like doing, starting in a comparatively minor rôle and taking my chance of promotion on merit, provided that there was a reasonable hope of continued employment when the present "flap" is over.

It would be interesting to hear other views on the subject.

Berkshire. ONCE BITTEN.

IN BRIEF

Commenting on Mr. J. Brown's letter (January 4th) on the difficulty of obtaining spares for a vintage D.H.53, G/C. C. S. Morice (London sales manager of the Dunlop aviation division) says that the Dunlop Rubber Co., Ltd., always endeavour to assist the owners of such aircraft in the matter of providing obsolete types of tyres and brakes. He adds that he has communicated with the newly formed Vintage Aeroplane Club with a view to helping its members in this direction.

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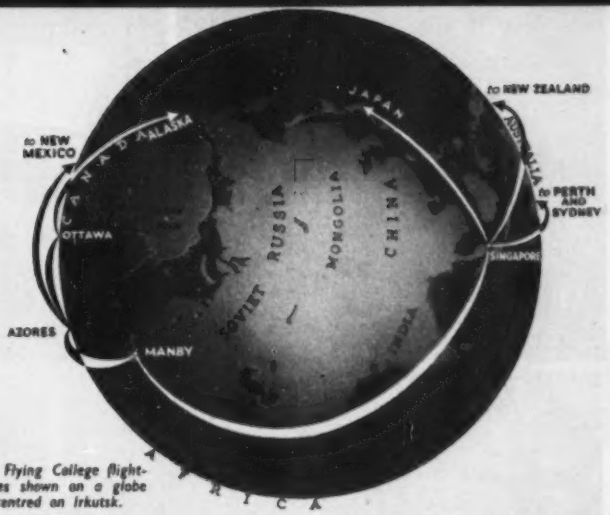


The Flying College flight-routes shown on a globe centred on Irkutsk.

R.A.F. FLYING COLLEGE'S GLOBAL FLIGHTS

AS we briefly recorded last week, the second course to pass through the R.A.F. Flying College at Manby, Lincolnshire, are nearing the end of their final term and, to complete their year's training, have left with members of the staff on a series of six world flights, all of which are due to terminate at Manby on the afternoon of February 6th.

The distant destinations are in Canada, Alaska, New Zealand, Australia, the United States and Japan. Meteorological and ground conditions and the geography of the routes flown will be studied but the chief value of the flights will lie in the visits made to Commonwealth and American service units and research establishments. No security restrictions are imposed on any conversations that may take place abroad and since the College course is instituted to produce future air commanders, such talks are likely to be at a fairly high level.

In round figures the total distance of these six flights is some 100,000 n.m., which will involve about 550 hours' flying.

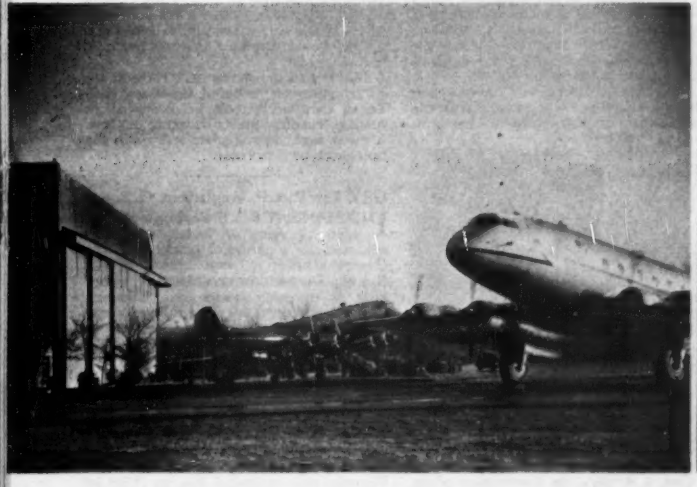
The first aircraft away was a Hastings which left dead on time at 10.00 hr on Monday, January 7th, on its first leg to the Azores *en route* for the United States. In the three weeks spent in America eight U.S.A.F. and U.S.N. bases will be visited in the following order: Andrews Field to Naval Air Station, Norfolk, Virginia; Wright-Patterson Air Force Base, Dayton, Ohio; Holloman Air Force Base, Almogordo, New Mexico; Carswell Air Force Base, Fort Worth, Texas; Eglin Air Force Base, Valpariso, Florida; Patrick Air Force Base, Cocoa, Florida; and McDill Air Force Base, Tampa, Florida, which should be reached on February 1st.

In command of this team is W/C. R. Frogley, Senior Instructor at the College. A member is G/C. H. W. Mermagen, who will be remembered by many as one of the famous Stephenson—Scroggs—Mermagen inverted aerobatic trio at C.F.S. in 1937. He is now the Chief Instructor designate of the College.

First light of the next day, Tuesday, January 8th, saw the second departure—an Avro Lincoln, WD 143, for New Zealand. Commanded by W/C. R. I. K. Edwards, this team will have the greatest mileage to cover. On the outward journey the trunk route will be followed as far as Singapore, but here a detour will be made to visit Kuala Lumpur and study the air operations in progress against the Malayan banditry. On arrival at Wellington, trips will be made to meet the Air Board and H.Q. Staff, R.N.Z.A.F. Operational squadrons and training establishments at Ohakea and Wigram will next be visited and from Wigram the Lincoln will fly to Whenupai, whence it will proceed to Nandi in the Fiji Islands. Here the team will see the R.N.Z.A.F. flying boat squadron at Louthalla Bay. On leaving Fiji the aircraft

(Right) W/C. Frogley receives a farewell from A. Cdre. Ubee before taking off for the United States. (Left) The Hastings for America taxies out past a similar Handley Page type which is being prepared for the trip to Canada and Alaska.

"Flight" photographs



"Flight" photographs

(Top left) G/C. D. C. McKinley, the present Chief Instructor at the R.A.F. Flying College, with G/C. H. W. Mermagen, the C.I. designate. (Top right) The team for New Zealand get their weather briefing from the met. officer, Mrs. Press. (Bottom left) The Alaskan team in their special cold-weather clothing. (Bottom right) S/L. Lowrence and F/L. Sparrow demonstrate the adjustable fur-rimmed helmet fitted to Arctic flying suits.

SERVICE AVIATION . . .

will return to Singapore *via* Townsville, Australia, and again follow the trunk route back to Britain.

The long-range Lincoln *Aries III* was next away, at 09.00 hr on Wednesday January 9th. In command was S/L. R. G. Oakley, with two navigators, F/L. D. F. H. Grocott and F/L. A. D. Jillings, both of whom took part in the trans-polar flight made in the same aircraft last September. *Aries* has tankage for 4,600 gallons of fuel, which gives a still-air range of approximately 4,000 miles and an endurance of 23 hours. With this performance available, the timetable allowed for Singapore to be reached with only one stop—at Bahrein in the Persian Gulf.

From Singapore *Aries* was scheduled to fly on to Japan, stopping only at Clarke Field at Luzon in the Philippines, and reaching Haneda, near Tokyo, on January 15th. These long hops must have been extremely tiring for a team of ten cooped up in a bomber fuselage.

From Tokyo visits will be made to see the Australian Meteor Squadron, No. 77 R.A.A.F., and units of the U.S.A.F. in action in Korea. On the return flight from Singapore stops will be made at Negombo, Ceylon, and Habbaniya.

Leaving at the same time as *Aries* was another Lincoln, SX 953, with S/L. R. S. Radley as captain. This aircraft is to make a round trip of 22,500 miles to Australia and back. While in Australia visits will be made to R.A.A.F. H.Q., to the new college at Point Cook and to bomber and fighter squadrons. The most interesting visit of all, however, will be to the Guided Missile Research Establishment at Woomera.

Last of all to leave was the Hastings, WD 499, carrying the two teams visiting Canada and Alaska. This aircraft also left on the morning of Wednesday, January 9th, under the captaincy of G/C. D. C. McKinley, the present Chief Instructor of the College. From Ottawa the Alaskan team proceeded under S/L. J. T. Lawrence to the U.S.A.F. Base at Elmendorf. While in Alaska they will study the cold-weather operation of military aircraft and will also carry out survival exercises, testing the special clothing and equipment issued to each member of the team.

The Hastings making this trip has been fully winterized but will not stay with the Alaskan team: it will return to Canada to transport the other College party on its visits round the R.C.A.F. bases. When these calls are completed the aircraft will proceed to Eielson in Alaska to pick up the other team and return to England *via* Dorval, Bermuda and the Azores.

"Flight" photograph

A. Cdre. S. R. Ubee, the Commandant of the R.A.F. Flying College at Manby, Lincolnshire.

If all goes to schedule on this 100,000-mile venture, the six teams should foregather once more at R.A.F. Flying College Manby on February 6th—it has been suggested that a line-abreast finish across the airfield would display a delicate touch of finesse!

The return to Manby will leave about a fortnight to elapse before the course ends These two weeks will be occupied in writing, reading and discussing reports. A guest night in the mess will mark the conclusion of the course.

G.D. for R.A.F. Regiment Officers

PERMANENT R.A.F. Regiment officers, aged 25 years or under, may now volunteer for a period of service with the General Duties (Flying) branch of the R.A.F. They will be considered for either pilot or navigator duties and, following training, will serve for five years in operational units. At the end of their detachment they will resume their original ground defence role.

Hon. Air Commodores for A.C.A.F.

FIVE State Governors have accepted appointments as Honorary Air Commodores of squadrons of the Australian Citizen Air Force. Gen. Sir Dallas Brooks, K.C.B., C.M.G., D.S.O., Governor of Victoria, will command No. 21 (City of Melbourne) Fighter Squadron and Gen.

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SERVICE AVIATION . . .

Sir John Northcott, K.C.M.G., C.B., M.V.O., Governor of New South Wales, will take over No. 22 (City of Sydney) Fighter Squadron.

No. 23 (City of Brisbane) Fighter Squadron is to have Lt. Gen. Sir John Laverack, K.B.E., C.B., C.M.G., D.S.O., Governor of Queensland, in command and the Governor of South Australia, Lt. Gen. Sir Willoughby Norrie, K.C.M.G., C.B., D.S.O., M.C., has taken over No. 24 (City of Adelaide) Fighter Squadron.

The fifth unit, No. 25 (City of Perth) Fighter Squadron, will come under the command of Lt. Gen. Sir Charles Gairdner, K.C.M.G., C.B., C.B.E., who is the Governor of Western Australia.

R.A.F. Appointments

THE present Inspector General of the R.A.F., Air Marshal Sir Thomas M. Williams, is to become A.O.C-in-C. F.E.A.F. to relieve Air Marshal Sir Francis J. Fogarty, whose new appointment is not yet announced.

In March, Air Marshal Sir John W. Baker, who is now in command in the Middle East, will relieve Air Chief Marshal P. M. Sanders as Deputy C.A.S. Command of M.E.A.F. will be held temporarily by Air Marshal V. E. Groom until he is relieved by Air Chief Marshal Sanders. Later, in July, Air Marshal Groom will become A.O.C-in-C. Technical Training Command.

A. V-M. D. F. W. Atcherley has been appointed to take Air Marshal Groom's place as A.O.C. No. 205 Group, M.E.A.F., and he is flying himself out to the Canal Zone in a long-range Meteor 10.

After attending the 1951 course at the Imperial Defence College, G/C. A. G. Adnams has been appointed Director of Operations (1) at the Air Ministry, with the acting rank of air commodore. An earlier announcement stated that this post would be taken by A. Cdre. H. P. Fraser; but, instead, A. Cdre. Fraser has been appointed S.A.S.O. at Fighter Command to allow A. V-M. D. F. W. Atcherley to go to Egypt to take over No. 205 Group.

With effect from March 1st, A. V-M. E. B. Addison will become S.A.S.O. at Flying Training Command H.Q. and A. Cdre. L. Dalton-Morris is going to Air Ministry as Assistant C.A.S. (Signals). He will assume the acting rank of air vice-marshal.

From February 1st, A. Cdre. G. H. Randle will take over command of the Central Signals Establishment from A. Cdre. P. Jones, who is to become S.A.S.O. of No. 90 Group. The former S.A.S.O. of No. 90 Group, A. Cdre. C. A. Bell, has been appointed Chief Signals Officer, M.E.A.F.

A. V-M. C. E. N. Guest, who has been at the Air Ministry as Assistant C.A.S. (Operations), and who formerly commanded No. 1 Group, is to be A.O.C-in-C. Transport Command.

Cooper Trophy

AWARDED by Fighter Command to the Auxiliary squadron achieving the best air-to-air firing results, the Cooper Trophy has been won by No. 615 (County of Surrey) Squadron.

Mr. Winston Churchill, the Honorary Air Commodore of No. 615, has congratulated S/L. F. B. Sowrey, the commanding officer, on the unit's success. No. 601 (County of London) Squadron was placed second.

The trophy, which takes the form of a bronze figure surmounting a globe, was presented by W/C. Cooper. Previous contests were run as air races but last year's contest was decided on the squadron's records at armament practice camp during the three-month mobilization period. In future, firing for the trophy will take place during the summer camp. All operational pilots of the squadrons must compete.

No. 615 Squadron has now been completely re-equipped with Meteor 8s; previously they had Meteor 4s. The unit's training officer, F/L. A. H. Davis, has just completed his tour of duty with the squadron and has left to become P.A. to Air Marshal Sir Robert M. Foster, A.O.C.-in-C. 2nd T.A.F.

CORNWALL FROM CALIFORNIA: One of the first two Lockheed Neptunes to arrive in Britain for Coastal Command. They were flown from America to St. Eval, Cornwall, by R.A.F. crews and arrived on Sunday last. They will be used for short-range patrols.

Home Fleet's Spring Cruise

SHIPS of the Home Fleet have been assembling at Portland this week in preparation for the spring cruise, during which they will be based at Gibraltar for about two months.

The heavy squadron, commanded by Rear-Admiral Caspar John, will include the carriers H.M.S. *Indomitable*—wearing the flag of the new C-in-C., Admiral Sir George Creasy—and H.M.S. *Theseus*. These ships were due to start embarking their air groups yesterday.

The two carriers of the training squadron—H.M.S. *Indefatigable*, wearing the flag of Rear-Admiral R. M. Dick (Flag Officer Training), and H.M.S. *Implacable*—will join the Fleet at Gibraltar. Rear-Admiral John will fly his flag in *Theseus*.

Cochrane Cup Boxing

SEMI-FINAL contests, between Manby and Driffield, for the Cochrane Cup were held at Manby on Monday, January 7th. Results were very even despite the referee, F/L. Hannant, having had to stop no fewer than four of the bouts: the fly and welterweight contests went in favour of Manby and bantam and light-heavyweight in favour of Driffield. At the end of the evening's boxing the score stood at 15 points to each side and the contest was therefore decided by the result of the lightweight bout—unfortunately the least inspiring of the whole evening—which was won by A/C. Debussey of Driffield.

Half-Yearly Promotions

BELOW is a further selection from the list of half-yearly promotions issued by the Air Ministry. The remainder will appear next week.

Flight Lieutenant to Squadron Leader.—N. N. Ezekiel; C. H. Macfie, D.F.C.; E. R. Abbott, D.S.O., D.F.M.; J. G. Bishop, D.F.C.; J. E. D. Tayler; A. S. Cade; S. A. E. Munns, D.F.M.; P. C. Barber; J. R. Robinson, A.F.C.; F. E. Clark; D. C. Furse, D.F.C.; B. G. Aston, D.F.C.; M. D. Wylie, D.F.C.; W. E. Thomas; R. D. Doleman, D.S.O., D.F.C.; J. B. C. H. Graves; J. C. Button, D.S.O.; D.F.C.; F. K. Hindle, D.F.C.; N. P. W. Conquer; W. R. Brooks, D.F.C.; R. K. Wilson, A.F.C.; D. B. Wills, D.F.C.; B. E. Hogan; W. R. Gellatly; J. L. Tempest, D.F.C.; M. Jones; J. A. Moss, D.F.C.; T. V. Dudding; H. D. Johnson, D.F.C.; R. V. F. Ellis; N. B. Buckley, D.F.C., A.F.C.; A. F. Boyd, D.F.C.; J. R. Goodman, D.F.C., A.F.C.; A. R. Middleton, D.S.O., D.F.C.; G. C. Nichols, D.F.C.; R. F. Clayton, D.F.C.; L. E. Copan; J. C. Cogill, D.S.O., D.F.C.; R. A. N. McCready; E. Cook, D.F.C.

Reunions

THE date for No. 166 Squadron's northern dinner is February 23rd. It will be held in Manchester and tickets are 7s. each. Particulars from Mr. F. C. Tighe, 31, Mayo Road, Sherwood Rise, Nottingham.

"Flight" photograph

WESTERN REUNION: W/C. W. Pitt-Brown, left, with a visiting group of German journalists watching a demonstration by the Biggin Hill Meteors. Newly appointed as Station Commander at Biggin Hill W/C. Pitt-Brown was previously Wing Commander Flying at Horsham St. Faith.

FIRST ACROSS: Into London Airport on January 6th came the first DC-6A Liftmaster to operate a transatlantic all-cargo service. Although owned by the American freight carriers, Slick Airways, the service is being operated on a weekly basis under charter to Pan American.

CIVIL AVIATION

TRANSATLANTIC BATTLE

AN attempt is now being made in Washington to resolve an argument between Pan-American World Airways and T.W.A. as to what form the American transatlantic route pattern shall take when the present arrangement expires on July 4th. Lengthy and well-reasoned cases have been submitted by both sides and the decision is now up to C.A.B.'s chief examiner, Mr. Francis Brown, to make recommendations to the Government on the conclusion of the official inquiry.

Briefly, the opposing airlines hold the following views. T.W.A. are of the opinion that the Government will be wavering in its policy of fostering international competition unless it grants them permanent routes. They claim to have earned permanent rights by reason of the fact that they have shown themselves to be the lowest-cost transatlantic operators. They also say that they are having considerable difficulty in retaining staff because of the temporary nature of the present permit. P.A.W.A., who seven years ago proposed that they should be granted a virtual monopoly of all American international routes, are now in favour of conserving the present competitive pattern established by President Truman in 1950. This, of course, gives the public a choice between the two U.S. airlines to the four principal traffic-centres of Europe. T.W.A. are urging 16 route-changes, among them the restoration of their monopoly on flights to Paris and Rome, while at the same time retaining the system of direct competition with P.A.W.A. to London and Frankfurt.

The vice-president of P.A.W.A., General Harris, has voiced his company's objection in these strong terms: "What T.W.A. wants is not a plan of area competition but an area from which competition is excluded. We should both stop this wrangling over routes and get out and sell more tickets."

It will be interesting to see which way the decision goes; as a pointer to what, in our opinion, will be the final result, it may be said that savings of nearly $7,000,000 for U.S. taxpayers resulted from the introduction of the competitive pattern now in force. It therefore seems likely that the present plan may be retained, though perhaps with a number of modifications designed to give a more permanent aspect to some of T.W.A.'s services.

MEXICO GETS A D.C.A.

IN Mexico, civil aviation has finally attained an official status with the establishment of a separate Mexican Aeronautical Administration. Previously, air-transport activities had been under the direction of the Department of Communications and Public Works. The present move has been taken to step up the rate of development of Mexico's airline system. The new controlling organization will be divided into administrative and technical departments. The latter will devote itself to the provision of better traffic-control facilities and will include a special "airports office" which has been created to study methods for improving airport construction and operation.

The Mexican Government has announced that a total of 42,000,000 pesos (about $4,840,000) will be spent in the current year for the construction, improvement and maintenance of airports. In the airport programme the aim is to provide the country with a chain of well-distributed and fully equipped airfields with facilities to handle the largest types of current transport aircraft. Work has already begun on a new ten-storey building to house all offices of Mexico City's Central Airport, which itself is undergoing an extensive renovation programme. Special attention is being given also to the airport at Acapulco, and other airports to be developed include those at Nogales and Tijuana.

ITALIAN AIRLINE LIQUIDATED

AT a recent meeting of the shareholders of the Italian airline, Ali Flotte Riunite (ALI), it was decided to dissolve the company and to hand over its ten DC-3s to another operator, L.A.I. ALI's present services will continue until the Government has assigned these routes to other airlines. At the moment there is an agreement between ALI and L.A.I. which stipulates that the route sections in question should all be taken over by the latter firm. This arrangement is said to have been regarded unfavourably by other Italian operators and it is expected that pressure will be exerted on the Government to take measures that will protect the interests of other companies wishing to share this traffic.

CHANCES FOR BRITISH JETS

ACCORDING to Vice-Admiral Emory Land, president of the U.S. Air Transport Association, American airlines do not favour using Government money to develop jet-powered airliners. In aviation circles in Washington this seeming reversal of policy is attributed to a belief among the airlines that Congress is in no mood to finance a development programme for this type of equipment. This leaves America's airline industry with two alternatives. Either they can order such aircraft direct from U.S. manufacturers (and trust that they will eventually be able to recoup the high initial purchase prices which would be charged to cover the cost of their development), or they can acquire essential operating "know-how" by obtaining some of the British Comets which are to go into service this year.

Several airlines have already consulted U.S. manufacturers concerning the type of jet transports which they consider should be developed for commercial use.

IRISH AIRLINE'S LOSS

GENERAL sympathy will be extended to the Irish airline, Aer Lingus, which after 15 years of accident-free operation, was unfortunate enough to lose a Dakota, *St. Kevin*, in an accident on January 10th. During a storm the machine struck a slope of Moel Siabod, in Snowdonia, while flying on one of the London-Dublin night services. All the 23 persons on board (including the crew of three) lost their lives. The cause of the accident is unknown.

It will be recalled that in 1950 Aer Lingus was awarded the Cumberbatch Trophy in recognition of its excellent safety record.

T.C.A.'s GOOD YEAR

TRANS-CANADA AIR LINES report themselves well satisfied with last year's operations. Not only did passenger and commodity traffic far exceed all previous levels, but the company also experienced the best financial year in its history. During 1951 approximately 980,000 passengers flew over T.C.A.'s North American and international routes—18 per cent more than in 1950—while the volume of cargo and air express increased by about 15 per cent to 5,200,000 ton-miles. The carriage of "all-up" mail continued under a new agreement with the Post Office Department; the amount of mail lifted represented an increase of 7 per cent over 1950's figure and exceeded 4,300,000 ton-miles flown. It is estimated that increased revenues during 1951, coupled with careful control of expenditure should result in a very substantial financial surplus for the system as a whole.

A dominant influence on the growth of air traffic was the rapid expansion of the Canadian economy. The rising prosperity of the nation as a whole was keenly reflected in the amount of travel and shipment which took place last year as air transport kept pace with a general quickening of the business tempo. The gain in air-

CIVIL AVIATION . . .

transport popularity is also attributed to another factor: while the general cost of living reflected very marked increases, the cost of air travel showed no rise whatsoever during 1951, and has in fact been stabilized at a level not much higher, when compared with other commodity increases, than that at which it stood in 1939.

What is considered a particularly significant development was the unprecedented strength of passenger traffic during the winter months. The increase was achieved with little change in T.C.A.'s route-pattern; the only inaugural service of the year in fact, was the extension of the Montreal-London route to Paris.

During the summer the highest frequency of flights in T.C.A.'s history was scheduled. On trans-continental and inter-city routes, 500 additional seats daily were made available, an increase of 10 per cent over the peak scheduling of the year before. Winter programmes which became effective on November 1st called for a 20 per cent increase in hours flown over the previous winter and, in fact, involved almost as much flying as during the summer. On all services, approximately 14 per cent more capacity-ton-miles were placed at the disposal of the public than was the case in 1950.

No expansion of the existing fleet of 20 North Stars and 27 DC-3s was made, although at the height of the summer the North Stars were operated at a utilization rate in excess of 9½ hours a day, a figure which has not been exceeded by any other carrier with so diversified a route-pattern. The fleet as a whole flew more than 24 million revenue-miles, an increase of 11 per cent over 1950.

The outlook for continuing traffic growth, however, has persuaded T.C.A. to sign a contract for five Super Constellations, to be delivered in 1953. They will be used on overseas services. The Super Constellations were selected after a study had been made of current design-trends and the company is of the opinion that they will be capable of meeting all competition on the Atlantic route during the next few years.

To meet immediate requirements for expanded fleet-capacity, the company has three more North Stars ordered.

BRISTOL 170s FOR AER LINGUS

THE Irish airline, Aer Lingus, has announced an order for two Bristol 170 aircraft to augment its existing capacity for both passenger and cargo traffic. A third machine may be ordered at a later date. These Mk31Es will embody a number of special features and will have an internal arrangement which will permit quick conversion for either passenger or freight duties.

Passenger versions will have 40-46 seats and one of the high-density duties envisaged for them will be the carriage of pilgrims to Lourdes. Among the special features is a movable bulkhead which can be placed far enough aft to permit the carriage of mixed loads such as two cars and a number of passengers. The ambulance version will accommodate 21 stretcher cases. Later the Bristol Aeroplane Company will also design special fittings to form four separate horse-stalls.

TWENTY-FIVE YEARS of spectacular progress have elapsed since these eight employees of B.O.A.C. played their part in the beginning of the first British scheduled air route to be flown outside Europe. To mark the occasion a small reunion party was held at London Airport so that those whose duties had not yet brought them into contact with it might acquaint themselves with a new factor in British air transport history—namely, the introduction of the D.H. Comet. Two members of the party, now on ground duties, actually flew as aircrew members on the inaugural D.H.66 service between Cairo and Basra.

I.C. FERRY: Capt. Louis B. Elwin, A.F.C., has been appointed by Silver City Airways, Ltd., to manage their cross-channel vehicle ferry and freight services between Lympne and Le Touquet. Capt. Elwin was at one time C.F.I. of the Empire Central Flying School and has subsequently served as general manager of Cambrian Airways.

Last year Aer Lingus Dakotas carried 270,000 passengers, a 21 per cent increase on the total for the previous year. In addition to the Bristol 170s on order, the Company is also to receive Viscounts.

FAST PHOTOGRAPHY

COMPLETION of the first stage of an aerial survey of Mauritius is announced by the Aircraft Operating Co. of Africa, Ltd., a South African associate of the Hunting Group. The work is part of a contract recently awarded to that company by the Government of Mauritius.

A vital factor in all aerial photography is the weather, and in this instance it was of the utmost importance, as conditions over an island far out in the Indian ocean seldom permit an unobscured view of the landfall. Fortunately, favourable weather was reported at the time when the contract was actually being signed, and to take advantage of it an expedition was mobilized and got away in the short space of two days. As a result, the photographic work has been completed in one month, and the aircraft employed—a specially equipped Dakota—is now back at its home base at Rand Airport, Johannesburg.

Much of the future economic and engineering development of the island will be governed by the result of the aerial survey, as the flying stage of the contract will be closely followed by the compilation of aerial photographic mosaics and photogrammetric line-maps of specially selected areas.

BRETAGNES ORDERED

A CONTRACT has been signed between the French manufacturers S.N.C.A.S.O. and the Société de Transport Aérien d'Extrême Orient under which four SO.30P Bretagnes (powered by two Pratt and Whitney B-43s) will be delivered in the course of the year to this newly formed airline. The first two aircraft will be ready by the middle of the year and the remaining two should be available in the autumn. They will be used on overseas trunk routes of the French Union.

Six machines of this type have already been ordered by Air Algérie, and a further six by Air Maroc. An additional S.O.30P is also being converted for the personal use of the President of the French Republic.

MELBOURNE'S I.L.S.

BY installing a modified intrument landing system which, in fact, consists simply of a localizer, the Australian Department of Civil Aviation is hoping to reduce the number of fog and bad-weather diversions at Essendon Airport, Melbourne, by 85 per cent. A.N.A. is the first airline to complete a period of crew familiarization with this system.

The Melbourne localizer is a small radio-aid located at the end of the runway to assist traffic direction in conditions of low visibility. It incorporates a "marked" approach beam capable of giving accurate position indications to the pilot. The presentation in the cockpit is by a highly sensitive left-right indicator. The marker beacon presentation is both visual and oral and the receipt of a marker signal is used as an indication of when to lose altitude to the next stage of the approach.

During the training period, A.N.A.'s DC-4 pilots have made many straight-in approaches from nine miles out right down to the threshold of the runway, solely on instruments.

CIVIL AVIATION . . .

THE CHARTER YEAR

LOOKING back on 1951, most of the European charter companies (or "independent operators," as some now prefer to be called) would probably agree that the year was one of the most difficult in their history. Although the amount of business circulating was generally firmer than in previous years, for most of the time there was an acute shortage of aircraft, caused entirely by political disturbances in various parts of the world. Many of the smaller British companies went out of action altogether, leaving only a few operators with four-engined aircraft and an even smaller number with medium types such as Dakotas and Vikings. Despite the difficult situation, a very large amount of chartering for ordinary commercial purposes was done in the first six months of the year. The latter half, however, saw the almost complete disappearance of "independent" aircraft from the market—caused by heavy Government commitments and the blocking of all flights to the Far East because of fuel shortage.

The high-intensity airlift in the Pacific caused serious aircraft shortages in the United States, as most operators had had to commit their fleets for indefinite periods on Korean duties. American buyers came to Europe in order to purchase every available American-built machine; in some instances they bought second-hand Dakotas at treble their normal value. Many of the smaller companies were tempted to dispose of their fleets at what was obviously the peak of the market, and this led to the closing down of certain well-known British and French concerns.

By early spring the number of available medium-range aircraft in the United Kingdom had sunk to a critical level, the remainder being made up of Vikings which, in view of their higher operating costs, had previously been unable to compete with Dakotas on the open market. The unavoidable use of Vikings caused charter rates to rise very sharply. Towards the end of spring several companies acquired a number of ex-B.O.A.C. Yorks, and for the first time were able to operate fleets that were more or less suitable for world-wide duties. They were thus able to recapture to some extent the exceptionally heavy traffic to Australia and the Far East which had previously been carried by the charter sections of foreign airlines. The York, in fact, now forms the basis of British charter fleets. It is not very suitable for westbound Atlantic traffic, although flights have been made with reduced payloads. For eastbound routes, however, the York is comparable with the DC-4. Prior to 1951 the number of charter aircraft in Europe had been evenly spread over several countries, but by last summer the balance of owning-power had again reverted to this country. A few companies are still operating in France and Scandinavia, using aircraft of the short- and medium-range variety.

Of the types of loads carried it can probably be said that the British Government, using medium and heavy aircraft for the transfer of troops and freight to Middle and Far East destinations, were the most active charterers on the market. The heaviest freight loads, however, were transported between the U.K. and Sweden; outward flights were made with machinery and very heavy consignments of reindeer meat were lifted for the return journey. Until the opening of the Government trooping contracts in the summer, passenger movements were in a minority. The shortage of medium-range aircraft had left very little at the disposal of the tourist, and loads were mainly confined to ships' crews.

Most suitably equipped operators were only too willing to commit their aircraft for long periods on the high-density trooping contracts which the Air Ministry offered in the summer. Some of these, however, terminated at the end of the year and, so far as aircraft availability is concerned, the market is now enjoying a short breathing space. Though it constituted a serious blow to the charter companies at the time, the Persian oil situation has now ceased to affect operations.

One notable feature of the year's work was that no new seasonal traffic appeared at all; in fact, some actually disappeared from the market. The only seasonal loads were those for the carriage of tourists between spring and late summer. The general tendency has been for freight traffic (mainly manufactured goods and heavy items of machinery) to become much more stable, and for fixtures to be spread evenly over the year. The same cannot be said of the rates charged, which, after reaching a record peak in the summer, fell sharply towards the end of the year when aircraft were more freely available.

In the face of trying circumstances, the charter companies can be said on the whole to have had a good year, and the type of business transacted should give them confidence for the future.

ROYAL ARGONAUT COMMANDERS: When Princess Elizabeth and the Duke of Edinburgh fly to Nairobi on January 31st, on the first stage of their journey to Australia, their B.O.A.C. Argonaut will have two crews, who will change over at a refuelling point en route. Their names are:—

First Crew—Capt. R. C. Parker (left, above), Capt. T. B. Stoney, D.F.C., Nav/Off. C. T. Farndell, R/Off. J. Miller, Eng. J. L. Stanford-Smith, Chief Steward C. A. J. Cocklin, Stewards W. A. Norris and A. C. Forbes, and Stewardess C. M. Arpthorp. **Second Crew**—Capt. R. G. Ballantine (right, above), Capt. R. E. Hillichamp, D.F.C., Nav/Off. K. G. Crockett, R/Off. G. W. Cussons, Eng. F. Mallinson, Chief Steward S. R. J. Bruce, Stewards W. W. Rawlinson and K. Clarke, and Stewardess D. J. N. Palmer.

BREVITIES

AFTER 29 years of service as secretary-general of I.C.A.C. (originally I.C.A.N.), Dr. Albert Roper retired from office at the end of December. Dr. Roper, who once led a fighter squadron against such aces as Von Richthofen and Goering, has been honoured by 14 countries for his work in international aviation.

* * *

Eagle Aviation, Ltd., has signed a two-year agreement with the Air Ministry for carrying Empire Training Scheme personnel between the U.K. and Rhodesia. The contract, for which 45-seater Yorks will be used, envisages 40 flights per year.

* * *

The Norwegian independent airline, Braathen's S.A.F.E., has ordered two Lockheed Super-Constellations for delivery in 1953 and is trading-in three Skymasters. The airline carries mixed cargoes between Norway and the Far East.

* * *

A former chairman of B.O.A.C., Brig. Gen. A. C. Critchley, C.M.G., C.B.E., D.S.O., has become a director of Aquila Airways, Ltd. In the early post-war years, he was responsible for the Corporation's progressive flying-boat policy.

* * *

Douglas Aircraft are said to be "actively considering" construction of a 600 m.p.h., 50/70-passenger jet airliner, a prototype design of which is awaiting approval by the airlines. The constructors would have to rely on sufficient sales to recoup their £7 million investment for its initial development.

COMMERCIAL AVIATION COMMENTARY (Continued from page 70)

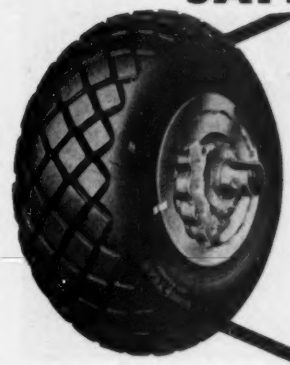
operator who quotes the lower figure may not long remain an operator!

So the broker who, because of the low rates he was securing, became very popular with his freight customers began to find himself most unpopular when he had to explain to his freighting clients that his own earlier enthusiasm had resulted in rates soaring. He became even more unpopular—with himself—when he found that the residue of operators were inclined to spurn the business he offered and, instead, wherever possible, to deal direct with the shippers—unless, of course, he was prepared to adjust his commission rates.

So the comparatively few remaining air-transport operators now feel that the brokers are more understanding of the fact that market manœuvrings which depressed rates to uneconomical levels quickly kill the charter market. More important still, the operators feel that the brokers are now on their side in realizing that the basic trouble with the air-transport market is the endless and increasing restrictive legislation which at every turn hampers the efforts of charter operators to develop business. This is where the fundamental difference between air and sea broking arises.

There are indications that the brokers are prepared to use their undoubtedly powerful influences to secure a new attitude to the freedom of air-freight movement and this alone should help the brokers and operators to get closer together. If combined effort can, in the end, result in international recognition of the practice of "freight consolidation," then air freighting will develop dramatically to the very great benefit of both the brokers and the operators.

SAFETY ON TOUCHDOWN



GOODYEAR

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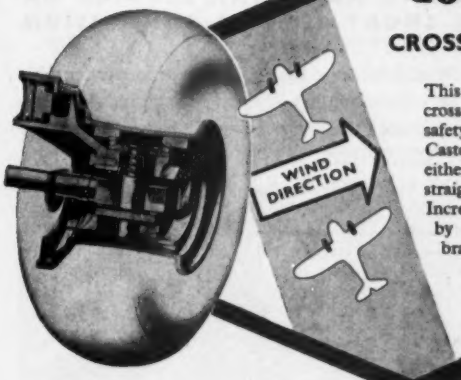

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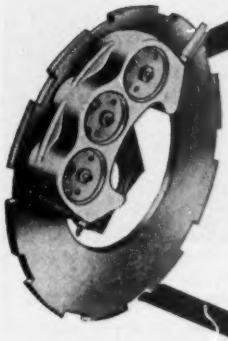

GOODYEAR

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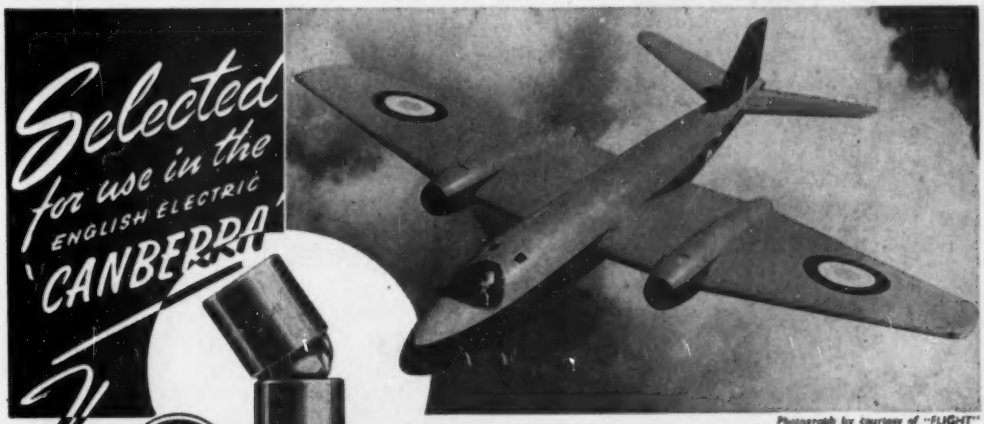

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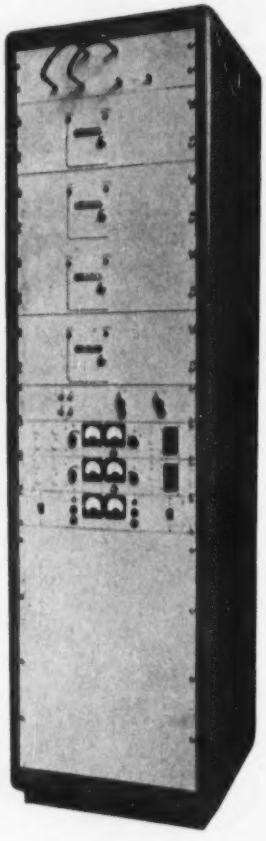

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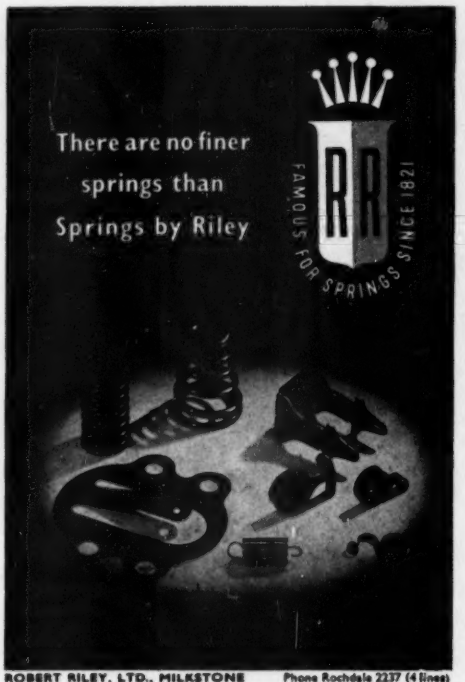

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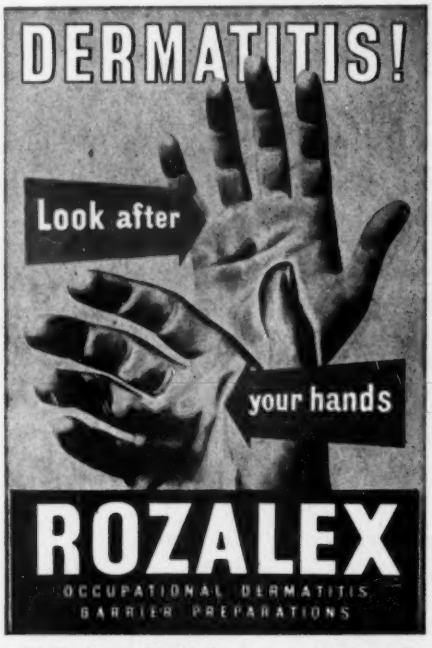

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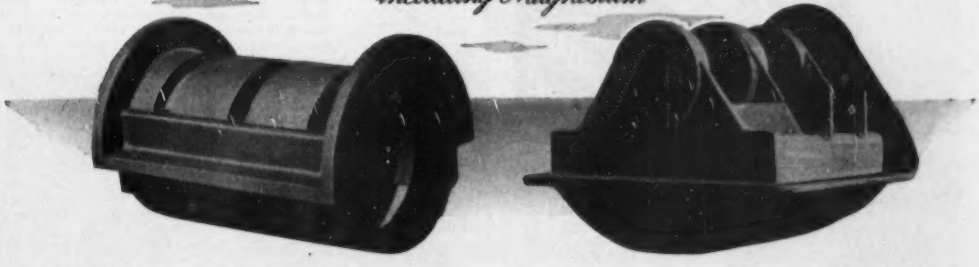

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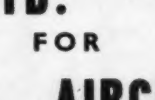

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P.S.—At the end of last year we published a little line • to the effect that 32 distinct types of aircraft had been sold by us in 1951—then of all things, in the closing hours of December we sold a Bird. A used Autocar is now on its way to the Antipodes. Please excuse the postscript.

STATISTICS have always fascinated us as the tolerant reader of these columns will have gathered. "Facts," Horace tells us, "are the fruits of science," and who are we to argue? They are neat and tidy and catalogued. The dilligent searcher can always find his answer whether it be the area of Lake Nicaragua, the population of Mbono or the number of plate-layers in Swindon with aunts in the W.R.A.F.

IT was in this spirit of research that Horace, our Tame Stressman, scanned the advertisements of a popular aviation magazine of twenty years ago. A well-known firm of Aeronautical Consultants were advertising under a box number for a young, "erudite" stressman—yes, you have guessed it! Distinguished and greying at the temples he is still with us, still tame, still more erudite.

WE found an advertisement for the Beardmore "Wee-Bee," designed years before by our Managing Director. It was offered as an interesting veteran (the Wee-Bee) for £125 complete with a Bristol Cherub engine (1 hour since overhaul), full dual, new C. of A., finished in blue and silver, etc. The perfect mount for the . . . . Top speed 75 m.p.h., landing speed 30 m.p.h.

WE noted that prices were high in those days compared with today and this in itself is pretty breathtaking if not unique. A good Fairmile "Elf" cost £750—a bad one £300. £600 would buy a Gipsy II Moth, whilst a Gipsy I cost all of £985. A man with £625 could own an Avro "Avian" IV with a C. of A. and a Hermes engine—while those in the lower income brackets could be content with a Cirrus III Spartan, or a Genet II Mariet at £250—of course a Beardmore "Wee-Bee."

PRICES of other items surprisingly enough, were lower. Solo flying in beautiful surroundings was offered at 25s. per hour, whilst one of our present employees, then 9 years old, remembers winning the penny jackpot on the fruit machine at Sherburn-in-Elmet Flying Club thus acquiring 8/6 which proved sufficient to obtain enough Scotch whiskey partially to anaesthetize two adults and to allow enough purchasing power over for sufficient ginger-beer to be terribly sick behind the hangars.

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is accepting applications from qualified radio-navigators to be employed on Trans-Pacific services and based in Vancouver, B.C. Applicants must hold a Flight Navigator's Licence to ICAO standards, and also a Canadian Certificate of Proficiency in Radio, second-class or equivalent. Must be a British subject.—Give full particulars, age, education, experience, marital status, and how soon available, to Canadian Pacific Air Lines, Vancouver A.M.F., B.C., Canada. [7481

BLACKBURN AND GENERAL AIRCRAFT LIMITED HAVE VACANCIES FOR SENIOR AND INTERMEDIATE DRAUGHTSMEN AND STRESSMEN, WITH GOOD ENGINEERING TRAINING AND SOUND KNOWLEDGE OF AND EXPERIENCE ON ALL-METAL AIRCRAFT. ALSO, LOFTSMEN OR LOFTSWOMEN WITH EXPERIENCE OF AIRCRAFT WORK.—APPLICATIONS, GIVING PARTICULARS OF AGE, TRAINING, EXPERIENCE, ETC., TO THE PERSONNEL SUPERINTENDENT, BROUGH, E. YORKS. [7489

TECHNICAL ASSISTANTS
REQUIRED for aircraft structural research. Applicants are required to possess a degree or equivalent qualification and be capable of pursuing a programme of testing and subsequent analysis on aircraft structure problems mainly arising from projected designs. A knowledge of modern stress analysis techniques would be an advantage.
APPLICATIONS, stating age, education, qualifications, experience and salary required should be addressed to the Personnel Manager, Short Brothers and Harland, Ltd., Queen's Island, Belfast. [7505

VICKERS-ARMSTRONGS, Ltd., (aircraft section) have vacancies at Hurn Depot for the following staff:—
AIRCRAFT STRESSMEN,
JIG AND TOOL DRAUGHTSMEN
(aircraft experience preferable, but not essential).
APPLY, in writing, to the Employment Manager, Vickers-Armstrongs, Ltd., (Aircraft Section), Weybridge, Surrey. [7498

HANDLEY PAGE, Ltd., have vacancies for:—
AERODYNAMICISTS of degree standard or with H.N.C. in aero subjects. Previous experience preferred.
WIND tunnel technicians of degree standard or with H.N.C. in aero subjects. Previous experience preferred.
STRESSMEN of degree standard or with H.N.C. in aero subjects. Previous experience preferred.
WEIGHT control engineers with minimum qualifications of O.N.C. Previous experience preferred.
SENIOR design and intermediate draughtsmen, preferably with aircraft experience, for Cricklewood and Radlett offices. Consideration will be given to applicants with experience in light electrical or mechanical engineering. Possession of H.N.C. or H.N.C. (Mech. or Elect.) an advantage.
LOFTSMEN with previous experience of full scale layout work or similar workshop practice.
TECHNICAL authors, preferably with experience in the preparation of maintenance manuals, pilots' notes, technical specifications, etc.
TECHNICAL illustrators with previous experience in aircraft work.—Write, stating age, qualifications and details of experience, to: Staff Officer, Handley Page, Ltd., Cricklewood, London, N.W.2. [7231
NORMALAIR, Ltd., Yeovil, Somerset, require:—
TECHNICAL ASSISTANTS.
TECHNICAL CLERKS.
TECHNICAL WRITERS.
FOR design development, etc., of aircraft air conditioning and high altitude breathing equipment.
APPLY, giving age, experience, qualifications and salary required, to Personnel Officer.
LOCAL interviews arranged for selected applicants. [7341
DESIGN and detail draughtsmen are required for interesting work on the following:—
HIGH-PRESSURE hydraulic and electro-hydraulic components. Hydraulic servos for aircraft and special projects. Strength and functional test rigs for undercarriages and hydraulic components.
PREVIOUS experience on type of work not essential.—Applicants should write, stating age, experience and salary required, to Mr. R. J. Brown, Chief Draughtsman, British Messier, Ltd., Cheltenham Road East, Gloucester. [7481
WESTLAND AIRCRAFT, Ltd., Yeovil, Somerset, require:—
SENIOR and intermediate draughtsmen, Stressmen.
EXPERIENCED spares compilers.
APPLICANTS should state age, experience, qualifications and salary required, to Personnel Officer. [7510
A SENIOR thermodynamist required for an interesting and responsible post in the South of England.
APPLICATIONS are invited from suitable candidates holding a degree or equivalent and with experience in modern aircraft installations and power plants.
WRITE, giving particulars of age, experience, salary expected etc., to Box 6212. [7501
REQUIRED Link Trainer instructor for Reserve Flying School.—Apply, giving full details of experience, to Air Schools Ltd., Municipal Airport, Derby. [7508
DRAUGHTSMAN required by firm in Kent. Living accommodation available to suitable applicant required.—Box 6198. [7504

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SITUATIONS VACANT

APPLICATIONS are invited for the appointment of Works Manager of an aircraft overhaul and conversion works in the Midlands. Only applicants with a proved high standard of administrative ability, experience in production control and workshop practices will be considered.
THE works employs some 350 personnel and in addition to its main business of aircraft repair and conversion, it undertakes component production in its ancillary detail and machine shops. Salary will be at the rate of £1,500 per annum, but it is emphasised that only persons with top-level experience and qualifications will be considered.
PLEASE reply fully, giving age, education, experience, qualifications, previous employers and appointments held, which will be treated in utmost confidence.
PREVIOUS applicants need not apply.
BOX No. 60, Allardyce Palmer Ltd., 199 Kingsway, W.C.2. [7534
THE BRISTOL AEROPLANE CO., LTD., have vacancies with good prospects for advancement for:—
1. TECHNICIANS for work on guided weapons. Aero-dynamicists with degree and not less than one year's practical experience and with some knowledge of supersonics preferred.
2. Draughtsmen and senior draughtsmen with Higher National Certificate and experience on aircraft or light engineering work.
Apply, giving full particulars of experience, age and academic qualifications, to the Personnel Manager, the Bristol Aeroplane Co., Ltd. (Aircraft Division), Filton House, Bristol. [7474
APPLICATIONS are invited for the following positions in the Aircraft Division of the English Electric Co., Ltd., at Warton Aerodrome, near Blackpool.
1 Engineer for the design and development of a new supersonic wind tunnel project. Applicants should have good experience of this type of work. Degree or equivalent preferred. (Ref. 652A)
2 Engineer for flight test liaison with the South of England. Applicants should have technical experience in the aircraft industry and an honours degree in engineering or its equivalent. (Ref. 653A)
3 Engineers for aero-elastic and allied investigations. Applicants should have aerodynamic or structural training and experience. (Ref. 435H)
4 Engineer/mathematician for investigations into numerical methods for aerodynamic and allied calculations. Applicants should be graduates of first-class mathematical ability. (Ref. 954A)
PLEASE write, giving full details and quoting appropriate reference to English Electric Co., Ltd., Central Personnel Services, 24/30, Gillingham Street, London, S.W.1. [7493
MOTOR secretary required for flying club on the south coast. Preference given to flying instructor. Accommodation possibly available. Write, Box 6204. [7505
LICENSED engineers, A and C, or A, for light aircraft maintenance; C. of A. repairs and club duties; also fitters, airframe and engine, required, good rate of pay and prospects.
APPLY: Wolverhampton Aviation, Ltd., The Airport, Wolverhampton. [7506
FITTMAYORS and ratefixers required, accustomed to aircraft work, for the south-west area.—Write, giving full particulars, to Box L4343, A.K. Advg., 212a Shaftesbury Avenue, W.C.2. [7497
LICENSED radio engineer and radio mechanics at our base at Stansted Airport, Essex.—Apply by letter or telephone, to the Senior Radio Engineer, Aviation Traders (Eng.), Southend Airport, Essex. Tel.: Rochford 545691. [7502
JIG and tool draughtsmen required, fully experienced.—Applications, in writing, to Personnel Manager, Percival Aircraft, Ltd., Luton Airport, Beds., stating age, experience and salary required. [7500
ELECTRICAL inspector required with a good knowledge of the construction and testing of aircraft voltage regulators, knowledge of electronics an advantage.—Apply to Box 6223. [7502
PILOTS wanted for appointments in Jordan area. Commercial Licence for Canada and/or D.H. Rapide required.—For details write, Plumb, 353 Watford Road, St. Albans. Tel. 6107. [7500
URGENTLY required, estimators for original estimating work. Preferably with aircraft experience.—Apply in writing to the Personnel Manager, Boulton Paul Aircraft Ltd., Pendeford, Wolverhampton. [7542
APPLICATIONS are invited from design draughtsmen and stressmen; also technical assistants with combined design and performance experience for work on both reciprocating and gas turbine aero engines.
APPLICATIONS should state full particulars of experience and qualifications, and should be addressed to The Personnel Manager, The de Havilland Engine Co., Ltd., Stonegrove, Edgware, Middx. [7476
AIRCRAFT draughtsmen required for new premises by expanding firm. Also technical authors, preferably with electrical experience.—Write or phone Aviation Engineering Projects Ltd., 167, High Street, Hounslow 6431. [7516
THE COLLEGE OF AERONAUTICS has vacancies for experienced female air traffic control clerks and R/T operators. Hostel accommodation available.—Applications should be made in writing to The Registrar, The College of Aeronautics, Cranfield, Bletchley, Bucks. [7540
BRITISH EUROPEAN AIRWAYS have vacancies at Head Office, Ruislip, in project and development branch. Applicants should possess a degree in science or engineering and experience of aircraft performance work and flight testing.
PRACTICAL engineering training and flying experience advantageous. Commencing salary not less than £675 per annum. Applications in writing to Personnel Manager, B.E.A. Keyline House, Ruislip, Middlesex. [7501
MECHANICAL designers required by Joseph Lucas Ltd. for gas turbine combustion system. Higher National Certificate or equivalent essential. Good prospects.—Apply, giving full details of experience, to Personnel Department, Wood Top Works, Burnley. [7545
DETAIL draughtsmen for interesting work on gas turbine equipment required by large progressive firm in East Lancs. The positions are permanent and offer scope to younger men.—Write, stating full details of training and experience, to Box 6213. [7546
DESIGN engineers required for large engineering works in East Lancs. Must hold Higher National Certificate in mechanical engineering. Knowledge of gas turbine work an advantage.—Write, stating age and experience, to Box 6214. [7547
METHODS engineers having sound knowledge of sheet metal press work and aircraft assemblies required by large firm in East Lancs. Practical experience and technical background essential.—Apply, stating age and experience, to Box 6215. [7548

SITUATIONS VACANT

NAVIGATORS.—Eagle Aviation Ltd. have vacancies for navigating officers. Applicants should possess a Flight Navigator's Licence and preferably have experience in civil aviation.—Apply to "Operations Officer," Eagle Aviation Ltd., Luton Airport, Beds. [7544]

A TECHNICAL assistant for interesting and varied work in modern test laboratory of heat exchange equipment. Age 25-35.—Please apply in writing, stating age, experience and qualifications, to: Secretary, Delaney Gallay, Ltd., Cricklewood, N.W.2. [7706]

AIRCRAFT fitter assemblers required by de Havilland Aircraft Co., Hatfield. Good working conditions, modern equipment, superannuation scheme, opportunities for advancement.—Apply in person or by letter to Personnel Manager, or telephone Hatfield 2061. [7660]

TECHNICAL authors and illustrators required. Knowledge of M.O.S. procedure desirable.—Applications, in writing, stating age, experience and salary required to Personnel Manager, Percival Aircraft, Ltd., Luton Airport, Beds. [7658]

WEIGHT estimator required for work on fixed wing and helicopter aircraft. Apply, giving details of age, qualifications, experience and salary required to: Personnel Manager, Percival Aircraft, Ltd., The Airport, Luton, Beds. [7676]

GROUND instructor, ex-R.A.F., required to give lectures on aerodynamics, airmanship, navigation and meteorology to R.A.F. Reservists.—Apply, stating age, experience, to the Manager, No. 6 Reserve Flying School, Syvell Aerodrome, Northampton. [7663]

SENIOR and junior weight engineers required. Interesting work on new projects. Permanent positions offered to suitable applicants.—Apply, stating age, experience, qualifications and salary required, to Chief Designer, Gloster Aircraft Co., Ltd., Witcombe, Glos. [6913]

GLOSTER AIRCRAFT Co., Ltd., have vacancies for fully experienced aircraft structural and electrical draughtsmen.—Applications, in writing, stating age, experience and salary required, to Employment Officer, Gloster Aircraft Co., Ltd., Hucclecote, Glos. [6910]

TECHNICAL assistant required for design study section of aircraft company located in Bedfordshire. Principal duty will be aircraft performance estimation, but other work of related nature is envisaged.—Apply, with full details to Box No. 6262 quoting Reference M.7. [7702]

ADVANCED project of national importance requires A propulsion technicians with knowledge of aero or thermodynamic theory. Approximately Higher National Certificate standard.—Apply, stating age, experience and salary required, to Box No. 6260, quoting Reference M.6. [7623]

THE DE HAVILLAND AIRCRAFT COMPANY, LTD., Christchurch Aerodrome, Hampshire, have vacancies for the following: Experienced electrical engineering draughtsmen required accustomed to aircraft installation work.—Apply in writing to the Personnel Manager, stating age, experience, and salary required. [7619]

APPLICATIONS are invited from senior and intermediate size design draughtsmen; experience of aero engine design desirable but not essential.—Please write, stating age and giving details of previous experience in chronological order, to the Personnel Officer, The de Havilland Engine Co., Ltd., Stag Lane, Edgware, Middx. [7648]

ONE male test laboratory assistant required. National Certificate standard and preferably 2-3 years' experience on design and analysis of mechanical tests.—Applications, in writing, stating age, experience and salary required, to Personnel Manager, Percival Aircraft, Ltd., The Airport, Luton, Beds. [7697]

THE Supermarine Works of Vickers-Armstrongs Ltd., have vacancies for mechanical and structural engineering draughtsmen with aircraft experience preferred.—Write, giving full details of experience and salary required, to Personnel Department, Vickers-Armstrongs Ltd., Hursley Park, near Winchester. [7688]

RADIO officer holding 1st-class M.C.A. Licence required for air charter operations—mainly daily out and return flights in U.K. Permanent position, salary and pension scheme. Trainee who would qualify within three months would be considered.—Apply: Personnel Manager, Marshalls Flying School Ltd., Cambridge. [7701]

H. M. HOBSON, Ltd., invite applications for positions in the drawing office as follows: designers, detail and modification draughtsmen, checkers, stressmen. The work is concerned with interesting projects connected with fuel metering equipment and hydraulic flying controls for aircraft.—Hobson Works, Fordhouses, Wolverhampton. [6420]

EXPERIENCED stressman required, for responsible position in stress office. Minimum requirements B.Sc. (or equivalent), several years' experience, ability to take charge of stressing of complete aircraft.—Applications, in writing, to Personnel Manager, Percival Aircraft, Ltd., The Airport, Luton, Beds, giving details of training, experience, age and salary required. [6696]

FLYING instructor required for Reade Flying Training School at Syvell. Applicants must have held C.F.S. category and be on the R.A.F. Reserve, or be prepared to join.—Applications, stating age, qualifications, details of experience, should be made in writing to the Manager, Brooklands Aviation Ltd., Syvell Aerodrome, Northampton. [6945]

THE ENGLISH ELECTRIC CO., Ltd., has vacancies in London and Warton (near Blackpool) for aircraft stressmen. Suitably qualified men, having structural stressing experience should write giving full details and quoting Ref. 6B/S to Central Personnel Services, English Electric Co., Ltd., 24-30 Gillingham Street, London, S.W.1. [7651]

AIR SERVICE TRAINING, Ltd., require Category A flying instructor for Harter conversion duties at Karachi. Experience of Harvard, Fury and Tempest desirable. Salary approximately £2,000 per annum.—Applications should be made to the Commandant, Air Service Training, Ltd., Hamble, Southampton, marking letters and envelopes "F.I.P." [7599]

AIR FORCE, Naval, civil and helicopter aircraft all under design and development at Percival Aircraft, Ltd. applications are invited from senior and junior draughtsmen, and stressmen, for work on this interesting programme.—Write, giving details of experience and salary required, to Personnel Manager, Percival Aircraft, Ltd., Luton Airport, Luton, Beds. [6695]

DESIGNER draughtsmen required for interesting work on gas turbine aero engine test equipment. The work covers the design and detail of equipment for research, experimental and production projects from initial engine build procedure to component testing and final testing. Salaries in excess of £650 per annum will be considered for applicants capable of working on own initiative. Expenses paid to interview.—Apply to reference DDI, Personnel Manager, Armstrong Siddeley Motors, Limited, Coventry. [7527]

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SITUATIONS VACANT

SENIOR designer for aero engine gas turbine project design required in well-known firm in London area. Previous experience on mechanical design is essential. Good prospects of promotion for a suitably experienced and enterprising candidate.—Please write, stating full details of age, experience, qualifications and salary required, quoting Ref. AG3, to Box 6264. [7548]

THE GLOSTER AIRCRAFT Co. requires senior and intermediate stressmen to work on designs and projects of advanced interest. Excellent prospects of advancement for sound and energetic men.—Apply, in the first instance, giving full particulars of technical qualifications, age, experience and salary required, to The Chief Designer, Gloster Aircraft Co., Ltd., Hucclecote, Glos. [6911]

EXPERIENCED aerodynamicist required, for responsible position in aerodynamics department. Minimum requirements B.Sc. (or equivalent), several years' experience, ability to undertake all normal performance, stability and other aerodynamic work.—Applications, in writing, to Personnel Manager, Percival Aircraft, Ltd., The Airport, Luton, Beds, giving details of training, experience, age and salary required. [6698]

TECHNICAL assistants, both junior and senior, required in mechanical engineering department for work of national importance in connection with development of gas turbine engines. Excellent prospects exist in sections dealing with rig test of entire components and also static structure test and research in gears and bearings. Qualifications: degree or H.N.C.—Apply: Reference No. VI, Armstrong Siddeley Motors, Ltd., Coventry. [6693]

THE DE HAVILLAND AIRCRAFT COMPANY LTD., Christchurch Aerodrome, Hampshire, have vacancies for the following: Senior method engineers with experience in machine shop, sheet metal or fitting shop. Senior and junior jig and tool draughtsmen. Preferably with experience of assembly jigs as well as small tools.—Apply in writing to the Personnel Manager, stating age, experience, and salary required. [7618]

HANDLEY PAGE (Reading), Ltd., The Aerodrome, Woodley, Reading, have a vacancy in their Design Office for a senior stressman with good experience and a degree or Higher National Certificate with endorsements in aerodynamics or subjects. Also required is a qualified weights control engineer to take charge of small weights section.—Please send full particulars to the Personnel Officer. [6974]

RESEARCH engineer required for turbine laboratory. Experienced in precise measurement of gas flow and familiar with scientific experimental techniques. Successful candidate will operate plant and be responsible for care and accuracy of instrumentation. Write, stating age, qualifications and salary required, to the Personnel Officer, Sir George Godfrey and Partners, Ltd., Hampton Road, Hanworth, Middlesex. [7704]

SENIOR technical assistant required for weight investigation of gas turbine design schemes. Some centre design and/or stress experience desirable. Good opportunity for young engineer with H.N.C. to broaden experience. Work involves some engine stressing.—Applicants should write, giving age and previous experience in chronological order, to the Personnel Officer, The de Havilland Engine Co., Ltd., Stag Lane, Edgware, Middlesex. [7645]

NORMALAIR, Ltd., have vacancies for instrument mechanics with current "X" licences, for repair and overhaul of air conditioning and high altitude breathing equipment at London Airport. Rates of pay 3s. 6d. per hour, plus 3d. per hour bonus, and ability par up to 3s. per hour, 5-day 44-hour week. Selected applicants will be given an initial course at Yeovil.—Apply, Personnel Officer, Normalair Limited, Yeovil, Somerset. [7444]

DESIGN and development engineers are required by the English Electric Co., Ltd., for their gas turbine department at Rugby. Applicants should have a Higher National Certificate or a degree coupled with a practical engineering background preferably directly concerned with gas turbines.—Please write, giving full details of qualifications and experience, quoting Ref. 6A/D, to Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham street, London S.W.1. [7599]

AIR SERVICE TRAINING, Ltd., require engineering instructor specialised in allied trades and basic instruction, i.e. welding, blacksmithing, coppersmithing and basic fitting for an appointment in Pakistan in connection with air force apprentice training. Salary approximately £1,700 per annum. Application should be made to the Commandant, Air Service Training, Ltd., Hamble, Southampton, marking letters and envelopes "E.I." [7598]

DESIGN engineers wanted for experimental work on defence project. Previous experience required of any of the following: light engineering instruments, aircraft design, small electro-mechanical devices. Salary in accordance with experience and qualifications.—Please write giving full details, and salary required, quoting ref. 264D to Central Personnel Services, English Electric Company, Ltd., 24/30, Gillingham Street, London, S.W.1. [7517]

ARMSTRONG SIDDELEY MOTORS have a few vacancies for senior and junior stressmen to do work on strength investigations and calculations on gas turbine aero engines. Degree, Higher National Certificate or equivalent essential. This is work of prime national importance. There are also a few vacancies for senior and junior stressmen for work on the installation of gas turbines in aircraft.—Apply in some detail to Reference 6JS.1. [7690]

DRAUGHTSMEN of all grades are required by the Aircraft Division of the English Electric Co., Ltd., for employment at Warton or in West London. Though men with good aircraft structure or jet engine installation experience are preferred, those with other structural experience will be considered.—Write, giving full particulars, quoting Ref. 12AJ, to Central Personnel Services, English Electric Co., 26/30 Gillingham Street, London, S.W.1. [7662]

BRITISH EUROPEAN AIRWAYS require a route planning officer at Northolt to prepare operating data for B.E.A. services and to work a variable payload scheme. Including calculation of fuel requirements. Essential qualifications are considerable air experience as pilot or navigator and possession of a Flight Navigator's Licence or equivalent. Salary scale £600 by £25 to £1 per week.—Applications in writing to Personnel Officer, Flight Operations Department, B.E.A., Keyline House, Ruislip, Middlesex. [7694]

BRITISH EUROPEAN AIRWAYS have vacancies at Renfrew for planner/ratefixers. Applicants should have served five years' apprenticeship in engineering and have had five years' planning or ratefixing experience in manufacture or repair of aircraft, engines, components or accessories. Salary scale £10 by 5s. to £11 per week.—Applications in writing to Base Personnel Officer, British European Airways, Airport for Glasgow, Renfrew. [7694]

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NORMALAIR, Limited, Yeovil, Somerset, require first-class designers and development engineers for work on aircraft pressurising, air conditioning and high altitude breathing equipment. H.N.C. or its equivalent is minimum standard acceptable and applicants who should preferably have experience in light precision or instrument engineering, must apply, giving age, experience, qualifications and salary required to Personnel Officer. Selected applicants interviewed locally where convenient. [7506

AIR-INDIA INTERNATIONAL, Ltd., have a vacancy for an "A" and a "C" licensed ground engineer for one of their stations in Europe covering 749A Constellations and Cyclone C18BD1 engines. Applicants will be required to obtain equivalent Indian Ground Engineer's licences and arrangements will be made for a short visit to Air-India headquarters in Bombay for this purpose.—Applications, stating full particulars and salary required, should be submitted to: Technical Manager (Europe), Air-India International, Ltd., 35 Curzon Street, London, W.1. [7489

A VACANCY exists at the Supermarine Works of Vickers-Armstrongs, Ltd., for a technician in the Flight Test Section at Chilbolton Airfield, who will be engaged on interesting work concerning the development flight testing of new high-performance aircraft. Applicants should possess a degree or Higher National Certificate or equivalent qualification with aerodynamics as a subject.—Apply to Personnel Manager, Vickers-Armstrongs, Ltd., Hursley Park, Winchester, giving qualifications, age and experience. [7498

THE GLOSTER AIRCRAFT Co. requires the services of a number of aerodynamicists, (a) for design and project work, and (b) for flight test reduction. Opportunity exists for individuals to vary their experience within the Aerodynamics Department. Candidates with some years' experience preferred, but applications from juniors with sound mathematical ability will receive full consideration. —Apply in the first instance, giving full particulars of age, experience and salary required, to The Chief Designer, Gloster Aircraft Co., Ltd., Hucclecote, Glos. [5913

BRITISH EUROPEAN AIRWAYS have a vacancy for an investigation engineer whose duties will be associated with the development and defect investigation of aircraft maintained at Renfrew. Applicants must be fully trained aeronautical engineers with at least seven years' practical experience of high-powered plants and aircraft. Commencing salary, according to qualifications, not less than £550 per annum; maximum salary £720 per annum.—Applications, giving details of age and qualifications, to Senior Personnel Officer, Scotland, British European Airways, Renfrew. [7525

A. V. ROE AND CO., Ltd. invite applications for the post of deputy I/C wind tunnel in their aircraft research division at Woodford Aerodrome, Cheshire. Applicants should possess good academic qualifications with a sound knowledge of applied aerodynamics, and should have several years experience of testing and analysis of results; preference will be given to those possessing a knowledge of high-speed wind tunnels. The vacancy is on the Senior Staff and offers a good salary. —Applications should be made in writing, giving full details to the Labour Manager, A. V. Roe and Co., Ltd., Greengate, Middleton, Manchester. [7563

AIR-INDIA, Ltd., and Air-India International, Ltd. invite applications for the post of chief engineer in Bombay. Qualifications should include an engineering degree or equivalent, current A, B, C, D licences on modern transport types and considerable practical and administrative experience in the engineering side of airline operating, together with engineering planning. Initial contract for 3 years with 30 days' cumulative leave per year, plus local leave. Salary payable, approximately Indian Rs. 2,500 per month (equivalent to £2,250 per annum) or higher if experience and suitability justify.—Written applications in the first instance, with full particulars, to Technical Manager (Europe), Air-India International, Ltd., 35 Curzon Street, London, W.1. [7499

THE de Havilland Engine Co. Ltd. have the following technical vacancies available in the Experimental Test Beds Department of their Hatfield factory:—junior technical assistants for test work in connection with recording and analysing the performance data of development gas turbine engines. Good salaries and prospects to suitable applicants. Good canteen facilities, five-day week.—Please write, giving age, full details of previous experience and salary required, to the Personnel Officer, The de Havilland Engine Co. Ltd., Hatfield Aerodrome, Hatfield, Herts. [7539

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WELL-CONNECTED senior commercial Anson Rapide 1/F R.T., 25 types York to Tiger, requires ferry work, contract or casual. Most things considered except S/E fighters.—Box 6301. [7528

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WANTED—quantity of portable oxygen breathing sets, ex-R.A.F., similar to Mark 3 Type 6D/1330.—Box 7460. [7466

BY YOUNG aircraft engineer; detail work, light assembly, parts manufacture, from drawings. Precision work; materials must be provided.—Write Box 6979. [7492

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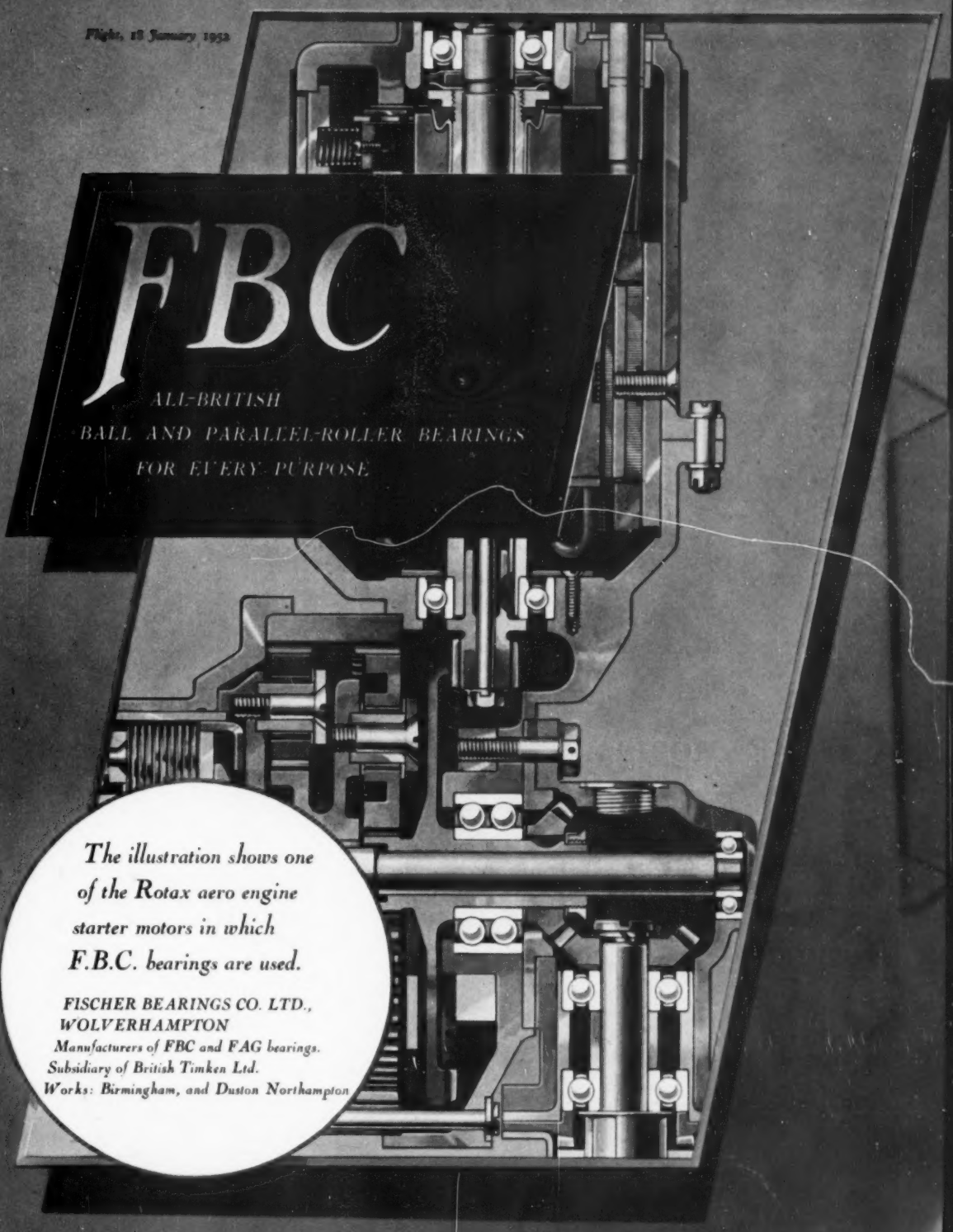

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